

**Step 1:** One factor ANOVA tests on time point of sample collection and measurements of PsbA, PSII active, PsbD, and rate constants (of inactivation, synthesis and degradation) to determine if there was a statistically significant difference between measurements over the sampling day in each species.

|                                     | <b>T. pseudonana</b>                                                                                                         | <b>T. punctigera</b>                                                                                                                                                                                                                                                  |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PsbA                                | Df Sum Sq Mean Sq<br>F value Pr(>F)<br>TimeofDay 6 4068 678<br>1.078 0.389<br>Residuals 49 30821 629                         | Df Sum Sq Mean Sq<br>F value Pr(>F)<br>TimeofDay 8 203<br>25.4 0.055 1<br>Residuals 27 12500<br>462.9                                                                                                                                                                 |
| PSII                                | Df Sum Sq<br>Mean Sq F value Pr(>F)<br>TimeofDay 6 1.115e+17<br>1.859e+16 0.653 0.688<br>Residuals 49 1.395e+18<br>2.847e+16 | Df Sum Sq Mean Sq<br>F value Pr(>F)<br>TimeofDay 8 2915<br>364.4 2.59 0.0306 *<br>Residuals 27 3799<br>140.7<br><br>4:00:00 PM-10:00:00 AM<br>-26.8036060 -51.244721<br>-2.362491 0.0236554<br>4:00:00 PM-2:00:00 PM<br>-29.2918935 -57.514062<br>-1.069725 0.0374752 |
| kPSII                               | Df Sum Sq<br>Mean Sq F value Pr(>F)<br>TimeofDay 4 1.820e-09<br>4.549e-10 0.229 0.919<br>Residuals 23 4.572e-08<br>1.988e-09 | Df Sum Sq<br>Mean Sq F value Pr(>F)<br>TimeofDay 2 1.397e-09<br>6.985e-10 1.709 0.219<br>Residuals 13 5.313e-09<br>4.087e-10                                                                                                                                          |
| rate constant of inactivation (kpi) | Df Sum Sq<br>Mean Sq F value Pr(>F)<br>TimeofDay 4 2.800e-10<br>6.910e-11 0.023 0.999<br>Residuals 23 6.779e-08<br>2.947e-09 | Df Sum Sq<br>Mean Sq F value Pr(>F)<br>TimeofDay 2 3.059e-10<br>1.530e-10 0.663 0.532<br>Residuals 13 3.000e-09<br>2.308e-10                                                                                                                                          |
| rate constant of PsbA synthesis     | Df Sum Sq<br>Mean Sq F value Pr(>F)<br>TimeofDay 4 4.691e-09<br>1.173e-09 1.731 0.181<br>Residuals 21 1.423e-08<br>6.777e-10 | Df Sum Sq<br>Mean Sq F value Pr(>F)<br>TimeofDay 2 3.690e-10<br>1.844e-10 0.234 0.795<br>Residuals 13 1.025e-08<br>7.888e-10                                                                                                                                          |
| rate constant of PsbA degradation   | Df Sum Sq<br>Mean Sq F value Pr(>F)<br>TimeofDay 3 2.701e-09<br>9.003e-10 1.228 0.326<br>Residuals 20 1.467e-08<br>7.333e-10 | Df Sum Sq<br>Mean Sq F value Pr(>F)<br>TimeofDay 2 1.379e-09<br>6.894e-10 1.093 0.364<br>Residuals 13 8.201e-09<br>6.308e-10                                                                                                                                          |
| PsbD                                | Df Sum Sq Mean Sq<br>F value Pr(>F)<br>TimeofDay 6 2000 333.3<br>0.301 0.931<br>Residuals 29 32074 1106.0                    | Df Sum Sq Mean Sq<br>F value Pr(>F)<br>TimeofDay 8 1468<br>183.5 0.306 0.957<br>Residuals 27 16163<br>598.6                                                                                                                                                           |

|                                         |                   |               |           |         |        |  |
|-----------------------------------------|-------------------|---------------|-----------|---------|--------|--|
| rate constant<br>of PsbD<br>synthesis   | Mean Sq           | Df            | Sum Sq    | F value | Pr(>F) |  |
|                                         | TimeofDay         | 2             | 1.935e-08 |         |        |  |
|                                         | 9.676e-09         | 4.727         | 0.0286 *  |         |        |  |
|                                         | Residuals         | 13            | 2.661e-08 |         |        |  |
|                                         | 2.047e-09         |               |           |         |        |  |
|                                         | lwr               | upr           | diff      | p adj   |        |  |
|                                         | 16:00:00-10:00:00 |               |           |         |        |  |
|                                         | -1.37375e-05      | -8.689120e-05 |           |         |        |  |
|                                         | 0.0000594162      | 0.8745201     |           |         |        |  |
|                                         | 22:00:00-10:00:00 |               |           |         |        |  |
| rate constant<br>of PsbD<br>degradation | Mean Sq           | Df            | Sum Sq    | F value | Pr(>F) |  |
|                                         | TimeofDay         | 2             | 8.100e-11 |         |        |  |
|                                         | 4.030e-11         | 0.033         | 0.968     |         |        |  |
|                                         | Residuals         | 13            | 1.588e-08 |         |        |  |
|                                         | 1.222e-09         |               |           |         |        |  |
|                                         | Mean Sq           | Df            | Sum Sq    | F value | Pr(>F) |  |
|                                         | TimeofDay         | 2             | 9.430e-10 |         |        |  |
|                                         | 4.714e-10         | 0.226         | 0.8       |         |        |  |
|                                         | Residuals         | 13            | 2.706e-08 |         |        |  |
|                                         | 2.081e-09         |               |           |         |        |  |

Because there was no statistically significant difference between sampling times for all of the above measurements, all further tests compare light vs. dark conditions and all samples collected at different time points during those conditions were pooled.

**Step 2:** Three factor ANOVAs tested the effects of (1) growth light, (2) sampling light vs. dark sampling time, and (3) photoperiod (light time duration) for measurements of PsbA, PSII active, PsbD, and rate constants (of inactivation, synthesis and degradation) in each species.

|                      |                      |
|----------------------|----------------------|
| <b>T. pseudonana</b> | <b>T. punctigera</b> |
|----------------------|----------------------|

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|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ps<br>bA | Df Sum Sq Mean Sq F value Pr(>F)<br>data1\$GrowthLight<br>1 9216 9216 48.016 1.90e-09<br>***<br>data1\$L.vs..D<br>1 1614 1614 8.407 0.00503<br>**<br>data1\$LightTime.h.<br>2 24451 12225 63.692 2.60e-16<br>***<br>data1\$GrowthLight:data1\$L.vs..D<br>1 1394 1394 7.261 0.00887<br>**<br>data1\$GrowthLight:data1\$LightTime.h.<br>. 2 5549 2775<br>14.456 5.87e-06 ***<br>data1\$L.vs..D:data1\$LightTime.h.<br>2 1888 944 4.918 0.01012 *<br>data1\$GrowthLight:data1\$L.vs..D:dat<br>a1\$LightTime.h. 2 2582 1291<br>6.726 0.00216 **<br>Residuals<br>68 13052 192                                                                       | Df Sum Sq Mean Sq F value Pr(>F)<br>data1\$GrowthLight<br>1 6283 6283 55.329 2.62e-09<br>***<br>data1\$LvsD<br>1 348 348 3.062<br>0.08711 .<br>data1\$LightTime.h.<br>1 658 658 5.792 0.02036<br>*<br>data1\$GrowthLight:data1\$LvsD<br>1 138 138 1.215 0.27639<br>data1\$GrowthLight:data1\$LightTime<br>.h. 1 1741 1741<br>15.330 0.00031 ***<br>data1\$LvsD:data1\$LightTime.h.<br>1 1013 1013 8.925 0.00459<br>**<br>data1\$GrowthLight:data1\$LvsD:data<br>1\$LightTime.h. 1 460 460<br>4.048 0.05037 .<br>Residuals<br>44 4996 114 |
| PS<br>II | Df Sum Sq Mean Sq F value Pr(>F)<br>data1\$GrowthLight<br>1 6.567e+16 6.567e+16 53.669<br>3.66e-10 ***<br>data1\$LvsD<br>1 1.764e+16 1.764e+16 14.418<br>0.000315 ***<br>data1\$LightTime.h.<br>2 1.669e+18 8.344e+17 681.953 <<br>2e-16 ***<br>data1\$GrowthLight:data1\$LvsD<br>1 1.386e+15 1.386e+15 1.133<br>0.290928<br>data1\$GrowthLight:data1\$LightTime.h<br>. 2 6.196e+16 3.098e+16<br>25.320 6.05e-09 ***<br>data1\$LvsD:data1\$LightTime.h.<br>2 1.578e+16 7.888e+15 6.447<br>0.002731 **<br>data1\$GrowthLight:data1\$LvsD:data1\$<br>LightTime.h. 2 2.880e+15 1.440e+15<br>1.177 0.314435<br>Residuals<br>68 8.320e+16 1.224e+15 | Df Sum Sq Mean Sq F value Pr(>F)<br>data1\$GrowthLight<br>1 15 15 0.100 0.75342<br>data1\$LvsD<br>1 1243 1243 8.309 0.00608<br>**<br>data1\$LightTime.h.<br>1 5693 5693 38.067 1.9e-07<br>***<br>data1\$GrowthLight:data1\$LvsD<br>1 122 122 0.813 0.37220<br>data1\$GrowthLight:data1\$LightTime<br>.h. 1 13 13<br>0.088 0.76788<br>data1\$LvsD:data1\$LightTime.h.<br>1 465 465 3.106<br>0.08493 .<br>data1\$GrowthLight:data1\$LvsD:data<br>1\$LightTime.h. 1 168 168<br>1.120 0.29562<br>Residuals<br>44 6580 150                    |

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| kP<br>SI<br>I | Df Sum Sq Mean Sq F value Pr(>F)<br>data1\$GrowthLight<br>1 3.502e-08 3.502e-08 142.412<br>1.70e-12 ***<br>data1\$L.vs..D<br>1 1.032e-08 1.032e-08 41.952<br>5.12e-07 ***<br>data1\$LightTime.h.<br>2 3.010e-09 1.500e-09 6.118<br>0.006248 **<br>data1\$GrowthLight:data1\$L.vs..D<br>1 4.520e-09 4.520e-09 18.395<br>0.000193 ***<br>data1\$GrowthLight:data1\$LightTime.h.<br>2 3.060e-09<br>1.530e-09 6.227 0.005789 **<br>data1\$L.vs..D:data1\$LightTime.h.<br>2 7.000e-11 4.000e-11 0.144<br>0.866380<br>data1\$GrowthLight:data1\$L.vs..D:dat<br>a1\$LightTime.h. 2 1.000e-10<br>5.000e-11 0.213 0.809840<br>Residuals<br>28 6.890e-09 2.500e-10 | Df Sum Sq<br>Mean Sq F value Pr(>F)<br>data1\$GrowthLight<br>1 9.653e-10 9.653e-10 8.485<br>0.010166 *<br>data1\$LvsD<br>1 2.678e-09 2.678e-09 23.542<br>0.000177 ***<br>data1\$LightTime.h.<br>1 5.557e-10 5.557e-10 4.884<br>0.042025 *<br>data1\$GrowthLight:data1\$LvsD<br>1 1.064e-09 1.064e-09 9.351<br>0.007513 **<br>data1\$GrowthLight:data1\$LightTime<br>.h. 1 1.884e-10<br>1.884e-10 1.656 0.216420<br>data1\$LvsD:data1\$LightTime.h.<br>1 1.749e-09 1.749e-09 15.370<br>0.001220 **<br>data1\$GrowthLight:data1\$LvsD:dat<br>a1\$LightTime.h. 1 1.808e-09<br>1.808e-09 15.894 0.001061 **<br>Residuals<br>16 1.820e-09 1.138e-10 |
| kp<br>i       | Df Sum Sq Mean Sq F value Pr(>F)<br>data1\$GrowthLight<br>1 4.393e-08 4.393e-08 703.538 <<br>2e-16 ***<br>data1\$LvsD<br>1 3.337e-08 3.337e-08 534.448 <<br>2e-16 ***<br>data1\$LightTime.h.<br>2 6.900e-10 3.500e-10 5.536<br>0.00942 **<br>data1\$GrowthLight:data1\$LvsD<br>1 2.178e-08 2.178e-08 348.887 <<br>2e-16 ***<br>data1\$GrowthLight:data1\$LightTime.h.<br>2 1.400e-10 7.000e-11<br>1.142 0.33364<br>data1\$LvsD:data1\$LightTime.h.<br>2 4.000e-11 2.000e-11 0.349<br>0.70830<br>data1\$GrowthLight:data1\$LvsD:dat<br>a1\$LightTime.h. 2 0.000e+00 0.000e+00<br>0.006 0.99412<br>Residuals<br>28 1.750e-09 6.000e-11                     | Df Sum Sq Mean Sq F value Pr(>F)<br>data1\$GrowthLight<br>1 1.300e-11 1.300e-11 0.040<br>0.843786<br>data1\$LvsD<br>1 7.364e-09 7.364e-09 23.457<br>0.000180 ***<br>data1\$LightTime.h.<br>1 9.730e-10 9.730e-10 3.100<br>0.097374 .<br>data1\$GrowthLight:data1\$LvsD<br>1 5.679e-09 5.679e-09 18.088<br>0.000607 ***<br>data1\$GrowthLight:data1\$LightTime<br>.h. 1 1.251e-09<br>1.251e-09 3.984 0.063259 .<br>data1\$LvsD:data1\$LightTime.h.<br>1 1.304e-09 1.304e-09 4.155<br>0.058406 .<br>data1\$GrowthLight:data1\$LvsD:dat<br>a1\$LightTime.h. 1 1.053e-09<br>1.053e-09 3.353 0.085772 .<br>Residuals<br>16 5.023e-09 3.140e-10      |

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| rate of PsbA synthesis | Df Sum Sq Mean Sq F value<br>Pr(>F)<br>data1\$GrowthLight<br>1 1.786e-09 1.786e-09 3.374<br>0.07771 .<br>data1\$LvsD<br>1 6.715e-09 6.715e-09 12.687<br>0.00145 **<br>data1\$LightTime.h.<br>2 1.800e-10 9.000e-11 0.170<br>0.84497<br>data1\$GrowthLight:data1\$LvsD<br>1 3.524e-09 3.524e-09 6.658<br>0.01587 *<br>data1\$GrowthLight:data1\$LightTime.h.<br>. 2 4.270e-10 2.130e-10<br>0.403 0.67247<br>data1\$LvsD:data1\$LightTime.h.<br>2 1.375e-09 6.870e-10 1.299<br>0.29005<br>data1\$GrowthLight:data1\$LvsD:data1\$<br>LightTime.h. 2 1.120e-09 5.600e-10<br>1.058 0.36161<br>Residuals<br>26 1.376e-08 5.290e-10 | Df Sum Sq Mean<br>Sq F value Pr(>F)<br>data1\$GrowthLight<br>1 5.059e-09 5.059e-09<br>24.426 0.000217 ***<br>data1\$LvsD<br>1 1.249e-09 1.249e-09<br>6.031 0.027735 *<br>data1\$LightTime.h.<br>1 6.500e-11 6.500e-11<br>0.314 0.583973<br>data1\$GrowthLight:data1\$LvsD<br>1 2.248e-09 2.248e-09<br>10.854 0.005319 **<br>data1\$GrowthLight:data1\$LightTime<br>.h. 1 7.610e-10<br>7.610e-10 3.674 0.075918 .<br>Residuals<br>14 2.900e-09<br>2.070e-10 |
|                        | Df Sum Sq Mean Sq F value<br>Pr(>F)<br>data1\$GrowthLight<br>1 3.900e-11 3.900e-11 0.073<br>0.78991<br>data1\$LvsD<br>1 1.734e-09 1.734e-09 3.209<br>0.08583 .<br>data1\$LightTime.h.<br>2 1.294e-09 6.470e-10 1.197<br>0.31947<br>data1\$GrowthLight:data1\$LvsD<br>1 6.290e-09 6.290e-09 11.640<br>0.00229 **<br>data1\$GrowthLight:data1\$LightTime.h.<br>. 2 5.240e-10 2.620e-10<br>0.485 0.62187<br>data1\$LvsD:data1\$LightTime.h.<br>2 2.100e-09 1.050e-09 1.943<br>0.16511<br>data1\$GrowthLight:data1\$LvsD:data1\$<br>LightTime.h. 2 2.880e-10 1.440e-10<br>0.267 0.76819<br>Residuals<br>24 1.297e-08 5.400e-10   | Df Sum Sq Mean Sq F<br>value Pr(>F)<br>data1\$GrowthLight<br>1 1.410e-09<br>1.410e-09 4.094 0.06256 .<br>data1\$LvsD<br>1 2.182e-09<br>2.182e-09 6.334 0.02465 *<br>data1\$LightTime.h.<br>1 7.400e-10 7.400e-10<br>2.149 0.16472<br>data1\$GrowthLight:data1\$LvsD<br>1 4.319e-09 4.319e-09<br>12.540 0.00326 **<br>data1\$GrowthLight:data1\$LightTime<br>.h. 1 1.590e-10<br>1.590e-10 0.461 0.50835<br>Residuals<br>14 4.822e-09<br>3.440e-10           |

|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ps<br>bD | <p> Df Sum Sq Mean Sq F<br/> value Pr(&gt;F)<br/> data1\$GrowthLight<br/> 1 15209 15209 56.049 2.23e-09<br/> ***<br/> data1\$LvsD<br/> 1 59 59 0.217 0.64378<br/> data1\$LightTime.h.<br/> 1 2878 2878 10.607 0.00217<br/> **<br/> data1\$GrowthLight:data1\$LvsD<br/> 1 2808 2808 10.347 0.00243<br/> **<br/> data1\$GrowthLight:data1\$LightTime.h.<br/> 1 7076 7076<br/> 26.077 6.78e-06 ***<br/> data1\$LvsD:data1\$LightTime.h.<br/> 1 503 503 1.855 0.18018<br/> data1\$GrowthLight:data1\$LvsD:data1\$<br/> LightTime.h. 1 753 753<br/> 2.776 0.10276<br/> Residuals<br/> 44 11939 271 </p> | <p> Df Sum Sq Mean Sq F<br/> value Pr(&gt;F)<br/> data1\$GrowthLight<br/> 1 7034 7034 35.059 4.41e-07<br/> ***<br/> data1\$LvsD<br/> 1 76 76 0.379 0.541172<br/> data1\$LightTime.h.<br/> 1 364 364 1.814 0.184880<br/> data1\$GrowthLight:data1\$LvsD<br/> 1 2608 2608 12.997 0.000791<br/> ***<br/> data1\$GrowthLight:data1\$LightTime<br/> .h. 1 3618 3618<br/> 18.033 0.000111 ***<br/> data1\$LvsD:data1\$LightTime.h.<br/> 1 819 819 4.081 0.049490<br/> *<br/> data1\$GrowthLight:data1\$LvsD:data<br/> 1\$LightTime.h. 1 6 6<br/> 0.028 0.867851<br/> Residuals<br/> 44 8827 201 </p> |
|          | <p> Df Sum Sq Mean<br/> Sq F value Pr(&gt;F)<br/> data1\$GrowthLight<br/> 1 3.000e-11 3.500e-11<br/> 0.010 0.9205<br/> data1\$LvsD<br/> 1 5.700e-10 5.690e-10<br/> 0.170 0.6863<br/> data1\$LightTime.h.<br/> 1 9.000e-10 9.020e-10<br/> 0.270 0.6116<br/> data1\$GrowthLight:data1\$LvsD<br/> 1 1.152e-08 1.152e-08<br/> 3.445 0.0846 .<br/> data1\$GrowthLight:data1\$LightTime.h.<br/> 1 3.800e-10 3.780e-10<br/> 0.113 0.7417<br/> Residuals<br/> 14 4.682e-08<br/> 3.344e-09 </p>                                                                                                             | <p> Df Sum Sq Mean<br/> Sq F value Pr(&gt;F)<br/> data1\$GrowthLight<br/> 1 3.551e-09 3.551e-09<br/> 5.498 0.0343 *<br/> data1\$LvsD<br/> 1 2.880e-10 2.880e-10<br/> 0.446 0.5151<br/> data1\$LightTime.h.<br/> 1 3.340e-10 3.340e-10<br/> 0.517 0.4840<br/> data1\$GrowthLight:data1\$LvsD<br/> 1 2.611e-09 2.611e-09<br/> 4.042 0.0641 .<br/> data1\$GrowthLight:data1\$LightTime<br/> .h. 1 9.170e-10<br/> 9.170e-10 1.419 0.2533<br/> Residuals<br/> 14 9.043e-09<br/> 6.460e-10 </p>                                                                                                      |

|                              |                                        |          |           |   |  |                                        |           |           |    |
|------------------------------|----------------------------------------|----------|-----------|---|--|----------------------------------------|-----------|-----------|----|
| rate of Ps bD de grad at ion | Df                                     | Sum Sq   | Mean Sq   | F |  | Df                                     | Sum Sq    | Mean Sq   | F  |
|                              | value                                  | Pr(>F)   |           |   |  | Sq                                     | F value   | Pr(>F)    |    |
|                              | data1\$GrowthLight                     |          |           |   |  | data1\$GrowthLight                     |           |           |    |
|                              | 1                                      | 1.26e-09 | 1.259e-09 |   |  | 1                                      | 3.079e-09 | 3.079e-09 |    |
|                              | 0.338                                  | 0.570    |           |   |  | 5.014                                  | 0.04189   | *         |    |
|                              | data1\$LvsD                            |          |           |   |  | data1\$LvsD                            |           |           |    |
|                              | 1                                      | 1.14e-09 | 1.143e-09 |   |  | 1                                      | 1.940e-10 |           |    |
|                              | 0.307                                  | 0.588    |           |   |  | 1.940e-10                              | 0.315     | 0.58338   |    |
|                              | data1\$LightTime.h.                    |          |           |   |  | data1\$LightTime.h.                    |           |           |    |
|                              | 1                                      | 3.90e-10 | 3.850e-10 |   |  | 1                                      | 3.036e-09 | 3.036e-09 |    |
|                              | 0.104                                  | 0.752    |           |   |  | 4.943                                  | 0.04317   | *         |    |
|                              | data1\$GrowthLight:data1\$LvsD         |          |           |   |  | data1\$GrowthLight:data1\$LvsD         |           |           |    |
|                              | 1                                      | 1.12e-09 | 1.115e-09 |   |  | 1                                      | 9.596e-09 | 9.596e-09 |    |
|                              | 0.300                                  | 0.593    |           |   |  | 15.626                                 | 0.00144   | **        |    |
|                              | data1\$GrowthLight:data1\$LightTime.h. |          |           |   |  | data1\$GrowthLight:data1\$LightTime.h. |           |           |    |
|                              | 1                                      | 1.80e-10 | 1.780e-10 |   |  | 1                                      | 7.990e-09 |           |    |
|                              | 0.048                                  | 0.830    |           |   |  | 7.990e-09                              | 13.011    | 0.00286   | ** |
|                              | Residuals                              |          |           |   |  | Residuals                              |           |           |    |
|                              | 14                                     | 5.21e-08 | 3.722e-09 |   |  | 14                                     | 8.597e-09 |           |    |
|                              |                                        |          |           |   |  | 6.140e-10                              |           |           |    |

**Step 3:** Next, two factor ANOVAs tested the effects of (1) growth light and (2) light vs. dark on samples from each photoperiod in each species.

#### T. pseudonana

|          | 4: 20 Diel Cycle                      | 8:16 Diel Cycle                  | 16:8 Diel Cycle                         |
|----------|---------------------------------------|----------------------------------|-----------------------------------------|
| Ps<br>bA | Df Sum Sq Mean Sq F value Pr(>F)      | Df Sum Sq Mean Sq F value Pr(>F) | Df Sum Sq Mean Sq F value Pr(>F)        |
|          | data4\$GrowthLight                    | data8\$GrowthLight               | data16\$GrowthLight                     |
|          | 1 9364 9364 50.656 2.44e-06 *         | 1 33 33.35 0.219 0.644           | 1 4884 4884 21.233 8.1e-05 *            |
|          | data4\$LvsD                           | data8\$LvsD                      | data16\$LvsD                            |
|          | 1 1596 1596 8.634 0.00964 *           | 1 305 304.58 2.001 0.170         | 1 773 773 3.361 0.077400 .              |
|          | data4\$GrowthLight:data4\$LvsD        | data8\$GrowthLight:data8\$LvsD   | data16\$GrowthLight:data16\$LvsD        |
|          | 1 101 101 0.545 0.47115               | 1 313 312.55 2.053 0.165         | 1 4046 4046 17.591 0.000249 *           |
|          | Residuals                             | Residuals                        | Residuals                               |
|          | 16 2958 185                           | 24 3654 152.24                   | 28 6441 230                             |
|          |                                       |                                  |                                         |
| PS<br>II | Df Sum Sq Mean Sq F value Pr(>F)      | Df Sum Sq Mean Sq F value Pr(>F) | Df Sum Sq Mean Sq F value Pr(>F)        |
|          | data4\$GrowthLight                    | data8\$GrowthLight               | data16\$GrowthLight                     |
|          | 1 4.470e+15 4.470e+15 2.652 0.12293   | 1 1098.8 1098.8 12.888 0.00147 * | 1 1.241e+17 1.241e+17 61.804 1.46e-08 * |
|          | data4\$LvsD                           | data8\$LvsD                      | data16\$LvsD                            |
|          | 1 1.594e+16 1.594e+16 9.457 0.00725 * | 1 196.9 196.9 2.310 0.14165      | 1 2.895e+16 2.895e+16 14.413 0.000723 * |
|          | data4\$GrowthLight:data4\$LvsD        | data8\$GrowthLight:data8\$LvsD   | data16\$GrowthLight:data16\$LvsD        |
|          | 1 4.681e+14 4.681e+14 0.278 0.60542   | 1 5.3 5.3 0.062 0.80583          | 1 2.828e+15 2.828e+15 1.408 0.245384    |
|          | Residuals                             | Residuals                        | Residuals                               |
|          | 16 2.697e+16 1.685e+15                | 24 2046.1 85.3                   | 28 5.623e+16 2.008e+15                  |
|          |                                       |                                  |                                         |

|                                                           |                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                |
|-----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| kp<br>SI<br>I                                             | Df Sum Sq Mean Sq F<br>value Pr(>F)<br>data4\$GrowthLight<br>1 9.601e-09 9.601e-09<br>59.91 0.0015 *<br>data4\$LvsD<br>1 3.134e-09 3.134e-09<br>19.56 0.0115 *<br>data4\$GrowthLight:data4\$LvsD 1 1.760e-09<br>1.760e-09 10.98 0.0295<br>*<br>Residuals<br>4 6.410e-10 1.600e-10       | Df Sum Sq Mean Sq F<br>value Pr(>F)<br>data8\$GrowthLight<br>1 2.118e-08 2.118e-08<br>88.394 6.94e-07 *<br>data8\$LvsD<br>1 3.348e-09 3.348e-09<br>13.975 0.00283 *<br>data8\$GrowthLight:data8\$LvsD 1 1.335e-09<br>1.335e-09 5.572<br>0.03602 *<br>Residuals<br>12 2.875e-09 2.400e-10   | Df Sum Sq Mean Sq F<br>value Pr(>F)<br>data16\$GrowthLight<br>1 6.575e-09 6.575e-09<br>23.414 0.000406 *<br>data16\$LvsD<br>1 4.689e-09 4.689e-09<br>16.700 0.001508 *<br>data16\$GrowthLight:data16\$LvsD 1 2.265e-09<br>2.265e-09 8.065<br>0.014901 *<br>Residuals<br>12 3.370e-09 2.810e-10 |
| kp<br>i                                                   | Df Sum Sq Mean Sq F<br>value Pr(>F)<br>data4\$GrowthLight<br>1 4.182e-09 4.182e-09<br>320.7 5.71e-05 *<br>data4\$LvsD<br>1 8.324e-09 8.324e-09<br>638.5 1.46e-05 *<br>data4\$GrowthLight:data4\$LvsD 1 5.289e-09<br>5.289e-09 405.7<br>3.59e-05 *<br>Residuals<br>4 5.200e-11 1.300e-11 | Df Sum Sq Mean Sq F<br>value Pr(>F)<br>data8\$GrowthLight<br>1 2.288e-08 2.288e-08<br>243.00 2.50e-09 *<br>data8\$LvsD<br>1 1.281e-08 1.281e-08<br>136.04 6.63e-08 *<br>data8\$GrowthLight:data8\$LvsD 1 7.709e-09<br>7.709e-09 81.86<br>1.04e-06 *<br>Residuals<br>12 1.130e-09 9.400e-11 | Df Sum Sq Mean Sq F<br>value Pr(>F)<br>data16\$GrowthLight<br>1 1.806e-08 1.806e-08<br>382.9 1.80e-10 *<br>data16\$LvsD<br>1 1.089e-08 1.089e-08<br>230.8 3.36e-09 *<br>data16\$GrowthLight:data16\$LvsD 1 7.730e-09<br>7.730e-09 163.9<br>2.35e-08 *<br>Residuals<br>12 5.660e-10 4.700e-11   |
| ra<br>te<br>of<br>Ps<br>ba<br>sy<br>nt<br>he<br>si<br>s   | Df Sum Sq Mean Sq F<br>value Pr(>F)<br>data4\$GrowthLight<br>1 3.670e-11 3.670e-11<br>0.143 0.7242<br>data4\$LvsD<br>1 1.076e-10 1.076e-10<br>0.420 0.5523<br>data4\$GrowthLight:data4\$LvsD 1 2.031e-09<br>2.031e-09 7.925 0.0481<br>*<br>Residuals<br>4 1.025e-09 2.562e-10           | Df Sum Sq Mean Sq F<br>value Pr(>F)<br>data8\$GrowthLight<br>1 1.368e-09 1.368e-09<br>1.512 0.2469<br>data8\$LvsD<br>1 3.932e-09 3.932e-09<br>4.345 0.0637<br>data8\$GrowthLight:data8\$LvsD 1 4.600e-11<br>4.600e-11 0.051 0.8262<br>Residuals<br>10 9.049e-09 9.050e-10                  | Df Sum Sq Mean Sq F<br>value Pr(>F)<br>data16\$GrowthLight<br>1 1.299e-09 1.299e-09<br>4.225 0.06227<br>data16\$LvsD<br>1 4.108e-09 4.108e-09<br>13.363 0.00329 *<br>data16\$GrowthLight:data16\$LvsD 1 2.078e-09<br>2.078e-09 6.758 0.02324<br>*<br>Residuals<br>12 3.689e-09 3.070e-10       |
| ra<br>te<br>of<br>Ps<br>ba<br>de<br>gra<br>d<br>at<br>ion | Df Sum Sq Mean Sq F<br>value Pr(>F)<br>data4\$GrowthLight<br>1 7.791e-10 7.791e-10<br>1.508 0.287<br>data4\$LvsD<br>1 1.424e-10 1.424e-10<br>0.276 0.627<br>data4\$GrowthLight:data4\$LvsD 1 1.649e-09<br>1.649e-09 3.192 0.149<br>Residuals<br>4 2.066e-09 5.165e-10                   | Df Sum Sq Mean Sq F<br>value Pr(>F)<br>data8\$GrowthLight<br>1 3.190e-10 3.190e-10<br>0.454 0.5192<br>data8\$LvsD<br>1 3.675e-09 3.675e-09<br>5.230 0.0515<br>data8\$GrowthLight:data8\$LvsD 1 9.500e-10<br>9.500e-10 1.352 0.2784<br>Residuals<br>8 5.622e-09 7.030e-10                   | Df Sum Sq Mean Sq F<br>value Pr(>F)<br>data16\$GrowthLight<br>1 1.870e-10 1.870e-10<br>0.424 0.5274<br>data16\$LvsD<br>1 0.000e+00 0.000e+00<br>0.001 0.9760<br>data16\$GrowthLight:data16\$LvsD 1 3.258e-09<br>3.258e-09 7.401 0.0186<br>*<br>Residuals<br>12 5.282e-09 4.400e-10             |

|                                                           |                                                                                                                                                                                                                                         |     |                                                                                                                                                                                                                                                                            |
|-----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ps<br>bD                                                  | Df Sum Sq Mean Sq F value Pr(>F)<br>data4\$GrowthLight<br>1 22.6 22.58 0.132<br>0.721<br>data4\$LvsD<br>1 259.7 259.69 1.518<br>0.236<br>data4\$GrowthLight:data4\$LvsD<br>1 30.9 30.86<br>0.180 0.677<br>Residuals<br>16 2737.0 171.06 | N/A | Df Sum Sq Mean Sq F value Pr(>F)<br>data16\$GrowthLight<br>1 23547 23547 71.648<br>3.33e-09 *<br>data16\$LvsD<br>1 244 244 0.744<br>0.3958<br>data16\$GrowthLight:data16\$LvsD<br>1 2245 2245<br>6.831 0.0143 *<br>Residuals<br>28 9202 329                                |
| ra<br>te<br>of<br>Ps<br>bD<br>sy<br>nt<br>he<br>si<br>s   | Sum Sq Mean Sq F value Df<br>Pr(>F)<br>data4\$GrowthLight 1<br>1.460e-09 1.460e-09<br>1.795 0.312<br>Residuals 2<br>1.627e-09 8.133e-10                                                                                                 | N/A | Df Sum Sq Mean Sq F value Pr(>F)<br>data16\$GrowthLight<br>1 6.600e-10 6.590e-10<br>0.175 0.683<br>data16\$LvsD<br>1 2.400e-10 2.430e-10<br>0.064 0.804<br>data16\$GrowthLight:data16\$LvsD<br>1 9.820e-09<br>9.815e-09 2.606 0.132<br>Residuals<br>12 4.519e-08 3.766e-09 |
| ra<br>te<br>of<br>Ps<br>bD<br>de<br>gr<br>ad<br>at<br>ion | Sum Sq Mean Sq F value Df<br>Pr(>F)<br>data4\$GrowthLight 1<br>1.217e-09 1.217e-09<br>1.987 0.294<br>Residuals 2<br>1.225e-09 6.126e-10                                                                                                 | N/A | Df Sum Sq Mean Sq F value Pr(>F)<br>data16\$GrowthLight<br>1 4.900e-10 4.94e-10<br>0.117 0.739<br>data16\$LvsD<br>1 7.700e-10 7.74e-10<br>0.183 0.677<br>data16\$GrowthLight:data16\$LvsD<br>1 8.400e-10<br>8.41e-10 0.198 0.664<br>Residuals<br>12 5.088e-08 4.24e-09     |

## T. punctigera

|      | 4:20 Diel Cycle                                                                                                                                                                                                                                  | 16:8 Diel Cycle                                                                                                                                                                                                                                      |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PsbA | Df Sum Sq Mean Sq F value<br>Pr(>F)<br>data4\$GrowthLight<br>1 6403 6403 52.117<br>2.05e-06 ***<br>data4\$LvsD<br>1 1498 1498 12.194<br>0.00301 **<br>data4\$GrowthLight:data4\$LvsD<br>1 790 790 6.431<br>0.02202 *<br>Residuals<br>16 1966 123 | Df Sum Sq Mean Sq F value<br>Pr(>F)<br>data16\$GrowthLight<br>1 1427.5 1427.5 13.189<br>0.00112 **<br>data16\$LvsD<br>1 20.0 20.0 0.185<br>0.67028<br>data16\$GrowthLight:data16\$LvsD<br>1 0.5 0.5 0.005<br>0.94437<br>Residuals<br>28 3030.7 108.2 |

|                              |                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                |
|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PSII                         | Df Sum Sq Mean Sq F value<br>Pr(>F)<br>data4\$GrowthLight<br>1 15 14.8 0.069<br>0.7965<br>data4\$LvsD<br>1 981 980.7 4.567<br>0.0484 *<br>data4\$GrowthLight:data4\$LvsD<br>1 4 4.0 0.019<br>0.8927<br>Residuals<br>16 3436 214.7                                                                   | Df Sum Sq Mean Sq F value<br>Pr(>F)<br>data16\$GrowthLight<br>1 3.6 3.57 0.032<br>0.860<br>data16\$LvsD<br>1 7.2 7.19 0.064<br>0.802<br>data16\$GrowthLight:data16\$LvsD<br>1 294.9 294.85 2.626<br>0.116<br>Residuals<br>28 3144.4 112.30                                                     |
| kPSII                        | Df Sum Sq Mean Sq F value<br>Pr(>F)<br>data4\$GrowthLight<br>1 4.900e-10 4.900e-10 7.745<br>0.04967 *<br>data4\$TimeofDay<br>1 4.598e-09 4.598e-09 72.702<br>0.00104 **<br>data4\$GrowthLight:data4\$TimeofD<br>ay 1 3.034e-09 3.034e-09<br>47.972 0.00228 **<br>Residuals<br>4 2.530e-10 6.300e-11 | Df Sum Sq Mean Sq F value<br>Pr(>F)<br>data16\$GrowthLight<br>1 5.019e-10 5.019e-10 3.842<br>0.0736 .<br>data16\$LvsD<br>1 2.867e-10 2.867e-10 2.195<br>0.1642<br>data16\$GrowthLight:data16\$LvsD<br>1 1.000e-13 1.000e-13 0.000<br>0.9845<br>Residuals<br>12 1.567e-09 1.306e-10             |
| kpi                          | Df Sum Sq Mean Sq F<br>value Pr(>F)<br>data4\$GrowthLight<br>1 1.705e-09 1.705e-09<br>1.721 0.2598<br>data4\$LvsD<br>1 5.714e-09 5.714e-09<br>5.768 0.0742 .<br>data4\$GrowthLight:data4\$LvsD<br>1 4.315e-09 4.315e-09<br>4.355 0.1052<br>Residuals<br>4 3.963e-09 9.910e-10                       | Df Sum Sq Mean Sq F value<br>Pr(>F)<br>data16\$GrowthLight<br>1 1.125e-09 1.125e-09 12.733<br>0.00386 **<br>data16\$LvsD<br>1 1.259e-09 1.259e-09 14.244<br>0.00265 **<br>data16\$GrowthLight:data16\$LvsD<br>1 8.497e-10 8.497e-10 9.615<br>0.00917 **<br>Residuals<br>12 1.060e-09 8.840e-11 |
| rate of<br>PsbA<br>synthesis | Df Sum Sq Mean Sq F<br>value Pr(>F)<br>data4\$GrowthLight<br>1 4.396e-09 4.396e-09<br>17.64 0.0523 .<br>Residuals<br>2 4.980e-10 2.490e-10                                                                                                                                                          | Df Sum Sq Mean Sq F value<br>Pr(>F)<br>data16\$GrowthLight<br>1 2.150e-09 2.150e-09 10.746<br>0.0066 **<br>data16\$LvsD<br>1 1.037e-09 1.037e-09 5.182<br>0.0419 *<br>data16\$GrowthLight:data16\$LvsD<br>1 1.522e-09 1.522e-09 7.606<br>0.0173 *<br>Residuals<br>12 2.401e-09 2.001e-10       |

|                                    |                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                          |
|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| rate of<br>PsbA<br>degradati<br>on | Df Sum Sq Mean Sq F value Pr(>F)<br>data4\$GrowthLight<br>1 1.798e-09 1.798e-09 109.6 0.009 **<br>Residuals<br>2 3.280e-11 1.640e-11                                                                                           | Df Sum Sq Mean Sq F value Pr(>F)<br>data16\$GrowthLight<br>1 4.320e-10 4.320e-10 1.082 0.3187<br>data16\$LvsD<br>1 1.477e-09 1.477e-09 3.699 0.0785 .<br>data16\$GrowthLight:data16\$LvsD<br>1 3.659e-09 3.659e-09 9.166 0.0105 *<br>Residuals<br>12 4.790e-09 3.990e-10 |
| PsbD                               | Df Sum Sq Mean Sq F value Pr(>F)<br>data4\$GrowthLight<br>1 8514 8514 44.223 5.58e-06 ***<br>data4\$LvsD<br>1 184 184 0.957 0.3425<br>data4\$GrowthLight:data4\$LvsD<br>1 1458 1458 7.575 0.0142 *<br>Residuals<br>16 3080 193 | Df Sum Sq Mean Sq F value Pr(>F)<br>data16\$GrowthLight<br>1 1154 1153.6 5.62 0.02488 *<br>data16\$LvsD<br>1 770 769.7 3.75 0.06296 .<br>data16\$GrowthLight:data16\$LvsD<br>1 2139 2139.2 10.42 0.00317 **<br>Residuals<br>28 5747 205.3                                |
| rate of<br>PsbD<br>synthesis       | Df Sum Sq Mean Sq F value Pr(>F)<br>data4\$GrowthLight<br>1 4.134e-09 4.134e-09 1.633 0.33<br>Residuals<br>2 5.063e-09 2.531e-09                                                                                               | Df Sum Sq Mean Sq F value Pr(>F)<br>data16\$GrowthLight<br>1 1.189e-09 1.189e-09 3.583 0.0827 .<br>data16\$LvsD<br>1 4.410e-10 4.411e-10 1.330 0.2713<br>data16\$GrowthLight:data16\$LvsD<br>1 1.756e-09 1.756e-09 5.293 0.0401 *<br>Residuals<br>12 3.981e-09 3.317e-10 |
| rate of<br>PsbD<br>degradati<br>on | Df Sum Sq Mean Sq F value Pr(>F)<br>data4\$GrowthLight<br>1 1.541e-08 1.541e-08 7.851 0.107<br>Residuals<br>2 3.925e-09 1.963e-09                                                                                              | Df Sum Sq Mean Sq F value Pr(>F)<br>data16\$GrowthLight<br>1 0.000e+00 0.000e+00 0.0 0.99901<br>data16\$LvsD<br>1 0.000e+00 0.000e+00 0.0 0.98800<br>data16\$GrowthLight:data16\$LvsD<br>1 5.256e-09 5.256e-09 13.5 0.00318 **<br>Residuals<br>12 4.672e-09 3.890e-10    |

**Step 4:** Results from two factor ANOVAs were used to determine which conditions could

be pooled when determining means for measurements of PsbA, PSII active, PsbD, and rate constants (of inactivation, synthesis and degradation) in each species.

### Statistics for Figure, cumulative diel photoinactivation, PsbA degradation and PsbA synthesis

1) Does light level or species have a statistically significant effect on cumulative diel PSII inactivation? YES

|                                    | Df | Sum Sq | Mean Sq | F value | Pr(>F)     |
|------------------------------------|----|--------|---------|---------|------------|
| data1\$Growth.Light                | 1  | 31595  | 31595   | 9.048   | 0.01090 *  |
| data1\$Species                     | 1  | 44838  | 44838   | 12.841  | 0.00376 ** |
| data1\$Growth.Light:data1\$Species | 1  | 21389  | 21389   | 6.125   | 0.02923 *  |
| Residuals                          | 12 | 41903  | 3492    |         |            |

|                 | diff    | lwr        | upr       | p adj     |
|-----------------|---------|------------|-----------|-----------|
| 300:pse-75:pse  | 162.00  | 37.94583   | 286.05417 | 0.0102329 |
| 75:pun-75:pse   | -32.75  | -156.80417 | 91.30417  | 0.8603720 |
| 300:pun-75:pse  | -17.00  | -141.05417 | 107.05417 | 0.9762252 |
| 75:pun-300:pse  | -194.75 | -318.80417 | -70.69583 | 0.0026685 |
| 300:pun-300:pse | -179.00 | -303.05417 | -54.94583 | 0.0050605 |
| 300:pun-75:pun  | 15.75   | -108.30417 | 139.80417 | 0.9808901 |

2) Does light level or species have a statistically significant effect on cumulative diel PsbA degradation? NO

|                                    | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
|------------------------------------|----|--------|---------|---------|--------|
| data1\$Growth.Light                | 1  | 4777   | 4777    | 0.697   | 0.420  |
| data1\$Species                     | 1  | 3556   | 3556    | 0.519   | 0.485  |
| data1\$Growth.Light:data1\$Species | 1  | 371    | 371     | 0.054   | 0.820  |
| Residuals                          | 12 | 82211  | 6851    |         |        |

3) Does light level or species have a statistically significant effect on cumulative diel PsbA synthesis? NO

|                                    | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
|------------------------------------|----|--------|---------|---------|--------|
| data1\$Growth.Light                | 1  | 470    | 470     | 0.053   | 0.822  |
| data1\$Species                     | 1  | 17515  | 17515   | 1.960   | 0.187  |
| data1\$Growth.Light:data1\$Species | 1  | 22392  | 22392   | 2.505   | 0.139  |
| Residuals                          | 12 | 107261 | 8938    |         |        |

3) Is there a statistically significant difference between cumulative diel PSII inactivation and PsbA degradation?

Growth Light 75, Species *T. pseudonana* - YES  
Welch Two Sample t-test

```
data: subset(data1, Growth.Light == 75 & Species ==
0)$CumulativePSII.inactivation.fmol.ufgprotein.1. and
CumulativePsbAdegradation.fmol.ufgprotein.1.
t = -2.9494, df = 13.805, p-value = 0.01069
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
-125.19456 -19.69226
sample estimates:
mean of x mean of y
57.0000 129.4434
```

Growth Light 75, Species *T. punctigera* - YES  
Welch Two Sample t-test

```
data: subset(data1, Growth.Light == 75 & Species ==
1)$CumulativePSII.inactivation.fmol.ufgprotein.1. and
CumulativePsbAdegradation.fmol.ufgprotein.1.
t = -5.1276, df = 17.441, p-value = 7.763e-05
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
-148.39360 -61.99322
sample estimates:
mean of x mean of y
24.2500 129.4434
```

Growth Light 300, Species *T. pseudonana* - NO  
Welch Two Sample t-test

```
data: subset(data1, Growth.Light == 300 & Species ==
0)$CumulativePSII.inactivation.fmol.ufgprotein.1. and
CumulativePsbAdegradation.fmol.ufgprotein.1.
t = 1.5091, df = 3.7558, p-value = 0.2103
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
-79.52779 258.64097
sample estimates:
mean of x mean of y
219.0000 129.4434
```

Growth Light 300, Species *T. punctigera* - YES  
Welch Two Sample t-test

```
data: subset(data1, Growth.Light == 300 & Species ==
1)$CumulativePSII.inactivation.fmol.ufgprotein.1. and
CumulativePsbAdegradation.fmol.ufgprotein.1.
t = -4.1659, df = 17.983, p-value = 0.0005817
alternative hypothesis: true difference in means is not equal to 0
```

95 percent confidence interval:

-134.55424 -44.33258

sample estimates:

mean of x mean of y

40.0000 129.4434

4) Is there a statistically significant difference between cumulative PSII inactivation and PsbA synthesis?

Growth Light 75, Species *T. pseudonana* - YES

Welch Two Sample t-test

data: subset(data1, Growth.Light == 75 & Species ==

0)\$CumulativePSII.inactivation.fmol.ufgprotein.1. and

CumulativePsbASynth.fmol.ufgprotein.1.

t = -3.4124, df = 16.775, p-value = 0.00337

alternative hypothesis: true difference in means is not equal to 0

95 percent confidence interval:

-160.07916 -37.68225

sample estimates:

mean of x mean of y

57.0000 155.8807

Growth Light 75, Species *T. punctigera* - YES

Welch Two Sample t-test

data: subset(data1, Growth.Light == 75 & Species ==

1)\$CumulativePSII.inactivation.fmol.ufgprotein.1. and

CumulativePsbASynth.fmol.ufgprotein.1.

t = -5.1345, df = 16.73, p-value = 8.697e-05

alternative hypothesis: true difference in means is not equal to 0

95 percent confidence interval:

-185.78526 -77.47614

sample estimates:

mean of x mean of y

24.2500 155.8807

Growth Light 300, Species *T. pseudonana* - NO

Welch Two Sample t-test

data: subset(data1, Growth.Light == 300 & Species ==

0)\$CumulativePSII.inactivation.fmol.ufgprotein.1. and

CumulativePsbASynth.fmol.ufgprotein.1.

t = 1.0296, df = 4.2566, p-value = 0.3581

alternative hypothesis: true difference in means is not equal to 0

95 percent confidence interval:

-103.1201 229.3587

sample estimates:

mean of x mean of y

219.0000 155.8807

Growth Light 300, Species T. punctigera - YES

Welch Two Sample t-test

data: subset(data1, Growth.Light == 300 & Species ==

1)\$CumulativePSII.inactivation.fmol.ufgprotein.1. and

CumulativePsbASynth.fmol.ufgprotein.1.

t = -4.3883, df = 17.696, p-value = 0.0003678

alternative hypothesis: true difference in means is not equal to 0

95 percent confidence interval:

-171.42809 -60.33332

sample estimates:

mean of x mean of y

40.0000 155.8807

5) Is there a statistically significant difference between cumulative diel PsbA degradation and synthesis? NO

Welch Two Sample t-test

data: data1\$CumulativePsbAdegradation.fmol.ufgprotein.1. and

CumulativePsbASynth.fmol.ufgprotein.1.

t = -0.83855, df = 28.395, p-value = 0.4087

alternative hypothesis: true difference in means is not equal to 0

95 percent confidence interval:

-90.97779 38.10319

sample estimates:

mean of x mean of y

129.4434 155.8807

FtsH Abundance Testing

##### Diel Cycle Pooling

#####

Is there a statistically significant difference in the concentration of FTsH between time points during one day? NO

75 LL, 4:20 diel cycle, T. punctigera

Df Sum Sq Mean Sq F value Pr(>F)

TimeofDay 4 4.562 1.1405 8.742 0.0176 \*

Residuals 5 0.652 0.1305

|                   | diff     | lwr        | upr         | p adj       |
|-------------------|----------|------------|-------------|-------------|
| 12:00:00-10:00:00 | -1.53030 | -2.9792312 | -0.08136885 | 0.0406351 * |
| 2:00:00-10:00:00  | -1.47825 | -2.9271812 | -0.02931885 | 0.0463695 * |
| 6:00:00-10:00:00  | -0.41805 | -1.8669812 | 1.03088115  | 0.7740974   |
| 8:00:00-10:00:00  | -1.65860 | -3.1075312 | -0.20966885 | 0.0296405 * |
| 2:00:00-12:00:00  | 0.05205  | -1.3968812 | 1.50098115  | 0.9998656   |
| 6:00:00-12:00:00  | 1.11225  | -0.3366812 | 2.56118115  | 0.1248417   |
| 8:00:00-12:00:00  | -0.12830 | -1.5772312 | 1.32063115  | 0.9954479   |
| 6:00:00-2:00:00   | 1.06020  | -0.3887312 | 2.50913115  | 0.1447924   |
| 8:00:00-2:00:00   | -0.18035 | -1.6292812 | 1.26858115  | 0.9838717   |
| 8:00:00-6:00:00   | -1.24055 | -2.6894812 | 0.20838115  | 0.0872132   |

300 LL, 4:20 diel cycle, *T. punctigera*

|           | Df | Sum Sq  | Mean Sq | F value | Pr(>F)   |
|-----------|----|---------|---------|---------|----------|
| TimeofDay | 4  | 0.18776 | 0.04694 | 8.487   | 0.0188 * |
| Residuals | 5  | 0.02766 | 0.00553 |         |          |

|                   | diff   | lwr        | upr       | p adj       |
|-------------------|--------|------------|-----------|-------------|
| 12:00:00-10:00:00 | 0.0388 | -0.2595412 | 0.3371412 | 0.9811139   |
| 2:00:00-10:00:00  | 0.1000 | -0.1983412 | 0.3983412 | 0.6809957   |
| 6:00:00-10:00:00  | 0.2196 | -0.0787412 | 0.5179412 | 0.1422018   |
| 8:00:00-10:00:00  | 0.3774 | 0.0790588  | 0.6757412 | 0.0197415 * |
| 2:00:00-12:00:00  | 0.0612 | -0.2371412 | 0.3595412 | 0.9127394   |
| 6:00:00-12:00:00  | 0.1808 | -0.1175412 | 0.4791412 | 0.2446633   |
| 8:00:00-12:00:00  | 0.3386 | 0.0402588  | 0.6369412 | 0.0306687 * |
| 6:00:00-2:00:00   | 0.1196 | -0.1787412 | 0.4179412 | 0.5495134   |
| 8:00:00-2:00:00   | 0.2774 | -0.0209412 | 0.5757412 | 0.0653098   |
| 8:00:00-6:00:00   | 0.1578 | -0.1405412 | 0.4561412 | 0.3363124   |

75 LL, 16:8 diel cycle, *T. punctigera*

|           | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
|-----------|----|--------|---------|---------|--------|
| TimeofDay | 6  | 3.765  | 0.6275  | 1.284   | 0.353  |
| Residuals | 9  | 4.398  | 0.4886  |         |        |

300 LL, 16:8 diel cycle, *T. punctigera*

|           | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
|-----------|----|--------|---------|---------|--------|
| TimeofDay | 5  | 0.4515 | 0.09031 | 1.076   | 0.429  |
| Residuals | 10 | 0.8390 | 0.08390 |         |        |

75 LL, 4:20 diel cycle, *T. pseudonana*

|           | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
|-----------|----|--------|---------|---------|--------|
| TimeofDay | 4  | 6.031  | 1.508   | 0.659   | 0.646  |
| Residuals | 5  | 11.443 | 2.289   |         |        |

300 LL, 4:20 diel cycle, *T. pseudonana*

|           | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
|-----------|----|--------|---------|---------|--------|
| TimeofDay | 4  | 6.031  | 1.508   | 0.659   | 0.646  |
| Residuals | 5  | 11.443 | 2.289   |         |        |

|           |   |       |       |       |       |
|-----------|---|-------|-------|-------|-------|
| TimeofDay | 4 | 9.80  | 2.450 | 1.023 | 0.477 |
| Residuals | 5 | 11.97 | 2.395 |       |       |

75 LL, 16:8 diel cycle, T. pseudonana

|           |    |        |         |         |        |
|-----------|----|--------|---------|---------|--------|
|           | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
| TimeofDay | 7  | 3.295  | 0.4707  | 1.293   | 0.361  |
| Residuals | 8  | 2.912  | 0.3640  |         |        |

300 LL, 16:8 diel cycle, T. pseudonana

|           |    |        |         |         |        |
|-----------|----|--------|---------|---------|--------|
|           | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
| TimeofDay | 7  | 2.644  | 0.3777  | 0.297   | 0.936  |
| Residuals | 8  | 10.178 | 1.2722  |         |        |

Based on the above tests we chose to count samples from the same growth conditions but taken at different time points as replicates.

##### Species

#####

Step 1: Is there a species difference in the concentration of FtsH? YES

|                |     |        |         |         |              |
|----------------|-----|--------|---------|---------|--------------|
|                | Df  | Sum Sq | Mean Sq | F value | Pr(>F)       |
| data1\$Species | 1   | 37.1   | 37.10   | 30.44   | 1.23e-07 *** |
| Residuals      | 174 | 212.0  | 1.22    |         |              |

##### T. pseudonana

#####

Step 1: Because there was a difference in the concentration of FtsH, two factor ANOVA with Tukey HSD testing the effects of growth light and day length on FtsH concentrations in T. pseudonana.

|                                     |    |        |         |         |             |
|-------------------------------------|----|--------|---------|---------|-------------|
|                                     | Df | Sum Sq | Mean Sq | F value | Pr(>F)      |
| data1\$GrowthLight                  | 1  | 8.49   | 8.494   | 4.757   | 0.03245 *   |
| data1\$LightTime                    | 1  | 21.06  | 21.058  | 11.793  | 0.00099 *** |
| data1\$GrowthLight:data1\$LightTime | 1  | 0.59   | 0.594   | 0.333   | 0.56597     |
| Residuals                           | 72 | 128.57 | 1.786   |         |             |

|              |            |            |             |             |
|--------------|------------|------------|-------------|-------------|
|              | diff       | lwr        | upr         | p adj       |
| 300:4-75:4   | 0.4371571  | -0.8912046 | 1.76551890  | 0.8225445   |
| 75:16-75:4   | -1.2744643 | -2.4563828 | -0.09254575 | 0.0295667 * |
| 300:16-75:4  | -0.4708268 | -1.6527453 | 0.71109175  | 0.7220597   |
| 75:16-300:4  | -1.7116214 | -2.8935400 | -0.52970289 | 0.0016260 * |
| 300:16-300:4 | -0.9079839 | -2.0899025 | 0.27393461  | 0.1900798   |
| 300:16-75:16 | 0.8036375  | -0.2109156 | 1.81819055  | 0.1683723   |

Step 2: Tables of Means

Tables of means

Grand mean

3.510099

```
data1$GrowthLight
  75 300
  3.18 3.84
rep 38.00 38.00
```

```
data1$LightTime
  4 16
  4.2 3.11
rep 28.0 48.00
```

```
data1$GrowthLight:data1$LightTime
      data1$LightTime
data1$GrowthLight 4 16
      75 3.98 2.71
      rep 14.00 24.00
      300 4.42 3.51
      rep 14.00 24.00
```

##### T. punctigera  
#####

Step 1: Becasue there was a difference in the concentration of FtsH, two factor ANOVA with Tukey HSD testing the effects of growth light and day length on FtsH concentrations in T. punctigera.

|                                     | Df | Sum Sq | Mean Sq | F value | Pr(>F)       |
|-------------------------------------|----|--------|---------|---------|--------------|
| data1\$GrowthLight                  | 1  | 1.672  | 1.672   | 6.226   | 0.0150 *     |
| data1\$LightTime                    | 1  | 0.777  | 0.777   | 2.893   | 0.0935 .     |
| data1\$GrowthLight:data1\$LightTime | 1  | 5.034  | 5.034   | 18.743  | 5.03e-05 *** |
| Residuals                           | 68 | 18.263 | 0.269   |         |              |

|              | diff        | lwr        | upr        | p adj       |
|--------------|-------------|------------|------------|-------------|
| 300:4-75:4   | -1.05267500 | -1.6098940 | -0.4954560 | 0.0000274 * |
| 75:16-75:4   | -0.78127500 | -1.2638408 | -0.2987092 | 0.0003628 * |
| 300:16-75:4  | -0.71212083 | -1.1946866 | -0.2295550 | 0.0013064 * |
| 75:16-300:4  | 0.27140000  | -0.2111658 | 0.7539658  | 0.4543280   |
| 300:16-300:4 | 0.34055417  | -0.1420116 | 0.8231200  | 0.2555440   |
| 300:16-75:16 | 0.06915417  | -0.3248591 | 0.4631675  | 0.9669843   |

Step 2: Tables of means  
Grand mean

2.534772

```
data1$GrowthLight
  75 300
```

2.69 2.38  
rep 36.00 36.00

data1\$LightTime  
4 16  
2.68 2.46  
rep 24.00 48.00

data1\$GrowthLight:data1\$LightTime  
data1\$LightTime  
data1\$GrowthLight 4 16  
75 3.21 2.43  
rep 12.00 24.00  
300 2.16 2.50  
rep 12.00 24.00