**Table S1.** Weekly measurements of seawater pH in tide pool and bulk seawater at Lower Portobello Bay, South Island, New Zealand (MacLeod, 2015). Note: pH is reported on the total hydrogen ion scale.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Date** | **Tide pool pH** | **SD** | **Bulk water pH** | **SD** |
| 2/08/2012 | 8.639 | 0.16 | 8.023 | 0.02 |
| 8/08/2012 | 8.745 | 0.17 | 8.080 | 0.02 |
| 16/08/2012 | 8.184 | 0.13 | 8.095 | 0.02 |
| 22/08/2012 | 8.134 | 0.26 | 7.909 | 0.02 |
| 30/08/2012 | 8.490 | 0.17 | 8.117 | 0.01 |
| 5/09/2012 | 8.409 | 0.21 | 8.353 | 0.17 |
| 14/09/2012 | 8.440 | 0.08 | 8.132 | 0.01 |
| 20/09/2012 | 8.961 | 0.23 | 8.170 | 0.02 |
| 28/09/2012 | 8.582 | 0.13 | 7.989 | 0.04 |
| 5/10/2012 | 8.212 | 0.05 | 8.165 | 0.01 |
| 9/10/2012 | 8.194 | 0.05 | 8.063 | 0.12 |
| 19/10/2012 | 9.078 | 0.12 | 8.151 | 0.02 |
| 22/10/2012 | 8.074 | 0.02 | 8.093 | 0.02 |
| 31/10/2012 | 8.936 | 0.09 | 8.227 | 0.01 |
| 6/11/2012 | 8.713 | 0.18 | 8.235 | 0.01 |
| 15/11/2012 | 9.002 | 0.16 | 8.192 | 0.01 |
| 19/11/2012 | 8.893 | 0.17 | 8.132 | 0.02 |
| 29/11/2012 | 8.331 | 0.11 | 8.162 | 0.01 |
| 7/12/2012 | 8.586 | 0.11 | 8.099 | 0.03 |
| 13/12/2012 | 8.437 | 0.13 | 7.950 | 0.01 |
| 18/12/2012 | 8.720 | 0.08 | 8.028 | 0.02 |
| 27/12/2012 | 8.541 | 0.11 | 8.035 | 0.02 |
| 4/01/2013 | 8.621 | 0.06 | 8.209 | 0.04 |
| 11/01/2013 | 8.361 | 0.20 | 7.984 | 0.04 |
| 17/01/2013 | 8.544 | 0.21 | 7.963 | 0.02 |
| 25/01/2013 | 8.387 | 0.32 | 8.083 | 0.06 |
| 29/01/2013 | 8.341 | 0.21 | 8.021 | 0.03 |
| 9/02/2013 | 8.054 | 0.17 | 7.834 | 0.07 |
| 22/02/2013 | 8.261 | 0.08 | 8.008 | 0.03 |
| 1/03/2013 | 8.609 | 0.18 | 8.048 | 0.06 |
| 8/03/2013 | 7.735 | 0.09 | 8.057 | 0.12 |
| 15/03/2013 | 8.390 | 0.29 | 7.956 | 0.08 |
| 19/03/2013 | 8.701 | 0.11 | 8.048 | 0.04 |
| 28/03/2013 | 8.611 | 0.20 | 8.074 | 0.29 |
| 3/04/2013 | 8.735 | 0.12 | 7.919 | 0.03 |
| 11/04/2013 | 9.087 | 0.19 | 8.285 | 0.09 |
| 16/04/2013 | 8.957 | 0.31 | 8.196 | 0.02 |
| 26/04/2013 | 8.524 | 0.20 | 7.940 | 0.04 |
| 2/05/2013 | 8.261 | 0.12 | 7.973 | 0.06 |
| 9/05/2013 | 8.528 | 0.17 | 8.013 | 0.03 |
| 17/05/2013 | 8.630 | 0.18 | 8.107 | 0.12 |
| 23/05/2013 | 7.599 | 0.12 | 8.118 | 0.10 |
| 30/05/2013 | 8.741 | 0.25 | 7.821 | 0.08 |
| 7/06/2013 | 8.347 | 0.12 | 8.082 | 0.01 |
| 14/06/2013 | 9.186 | 0.14 | 8.172 | 0.05 |
| 21/06/2013 | 7.785 | 0.27 | 7.873 | 0.03 |
| 28/06/2013 | 9.049 | 0.26 | 8.185 | 0.02 |
| 5/07/2013 | 7.793 | 0.08 | 7.990 | 0.01 |
| 11/07/2013 | 8.841 | 0.15 | 8.301 | 0.02 |
| 16/07/2013 | 8.943 | 0.13 | 8.295 | 0.01 |
| 25/07/2013 | 8.988 | 0.15 | 8.278 | 0.01 |
| 30/07/2013 | 8.871 | 0.07 | 8.205 | 0.01 |

**Table S2**. Post hoc analysis of differences in oxygen consumption rates between pH treatments within infection categories. Significant P-values are shown in bold type.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | **Estimate** | **SE** | **t-value** | **P-value** |
| ***Philophthalmus* sp.** | Intercept (pH 7.4) | 0.634607 | 0.141328 | 4.490 | **1.2852e-05** |
|  | pH 8.1 | 0.040392 | 0.038465 | 1.050 | 0.2951 |
|  | pH 7.6 | 0.106658 | 0.038381 | 2.779 | **0.0065** |
|  | Intercept (pH 7.6) | 0.741265 | 0.142762 | 5.192 | **5.6994e-07** |
|  | pH 8.1 | -0.066265 | 0.038604 | -1.717 | 0.0886 |
| ***M. novaezealandensis*** | Intercept (pH 7.6) | 1.23722 | 0.10748 | 11.511 | **3.2292e-23** |
|  | pH 8.1 | -0.07558 | 0.02818 | -2.682 | **0.0084** |
|  | pH 7.4 | 0.04862 | 0.02837 | 1.714 | 0.0880 |
|  | Intercept (pH 7.4) | 1.28585 | 0.10378 | 12.390 | **9.4213e-26** |
|  | pH 8.1 | -0.12420 | 0.02869 | -4.328 | **2.5186e-05** |
| ***Acanthoparyphium* sp.** | Intercept (pH 8.1) | 1.085051 | 0.084628 | 12.821 | **5.3279e-27** |
|  | pH 7.6 | 0.056348 | 0.021573 | 2.612 | **0.0098** |
|  | pH 7.4 | 0.060018 | 0.021678 | 2.769 | **0.0062** |
|  | Intercept (pH 7.4) | 1.145069 | 0.087264 | 13.122 | **7.1554e-28** |
|  | pH 7.6 | -0.003671 | 0.021587 | -0.170 | 0.8652 |
| **Uninfected** | Intercept (pH 8.1) | 0.57105 | 0.19042 | 2.999 | **0.0031** |
|  | pH 7.6 | 0.26147 | 0.03649 | 7.166 | **2.0384e-11** |
|  | pH 7.4 | 0.12377 | 0.03671 | 3.371 | **0.0009** |
|  | Intercept (pH 7.4) | 0.69482 | 0.19560 | 3.552 | **0.0004** |
|  | pH 7.6 | 0.13771 | 0.03596 | 3.829 | **0.0002** |

**Table S3.** Post hoc analysis of differences in oxygen consumption rates between infection categories within pH treatments. Significant P-values are shown in bold type.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |   | **Estimate** | **SE** | **t-value** | **P-value** |
| **8.1 pH** | Intercept (Ac.) | 0.703057 | 0.142572 | 4.931 | **1.5471e-06** |
|  | Ma. | -0.043098 | 0.038391 | -1.123 | 0.2625 |
|  | Ph. | 0.052583 | 0.038868 | 1.353 | 0.1773 |
|  | Un. | -0.117630 | 0.039149 | -3.005 | **0.0029** |
|  | Intercept (Ma.) | 0.659959 | 0.145067 | 4.549 | **8.6403e-06** |
|  | Ph. | 0.095681 | 0.039378 | 2.430 | **0.0158** |
|  | Un. | -0.074532 | 0.039750 | -1.875 | 0.0620 |
|  | Intercept (Ph.) | 0.755639 | 0.136116 | 5.551 | **7.6478e-08** |
|  | Un. | -0.170213 | 0.038336 | -4.440 | **1.3844e-05** |
| **7.6 pH** | Intercept (Ac.) | 1.039235 | 0.145556 | 7.140 | **1.1574e-11** |
|  | Ma. | -0.048299 | 0.037977 | -1.272 | 0.2046 |
|  | Ph. | 0.024764 | 0.038118 | 0.650 | 0.5163 |
|  | Un. | 0.042989 | 0.037913 | 1.134 | 0.2579 |
|  | Intercept (Ma.) | 0.990937 | 0.144244 | 6.870 | **5.7037e-11** |
|  | Ph. | 0.073063 | 0.038018 | 1.922 | 0.0558 |
|  | Un. | 0.091288 | 0.037740 | 2.419 | **0.0163** |
|  | Intercept (Ph.) | 1.064000 | 0.142078 | 7.489 | **1.3948e-12** |
|  | Un. | 0.018225 | 0.037559 | 0.485 | 0.6281 |
| **7.4 pH** | Intercept (Ac.) | 1.151344 | 0.073780 | 15.605 | **3.7455e-38** |
|  | Ma. | 0.009080 | 0.022243 | 0.408 | 0.6836 |
|  | Ph. | -0.052561 | 0.022104 | -2.378 | **0.0182** |
|  | Un. | -0.055924 | 0.022086 | -2.532 | **0.0119** |
|  | Intercept (Ma.) | 1.160424 | 0.069085 | 16.797 | **3.9596e-42** |
|  | Ph. | -0.061641 | 0.021811 | -2.826 | **0.0051** |
|  | Un. | -0.065004 | 0.021714 | -2.994 | **0.0030** |
|  | Intercept (Ph.) | 1.098783 | 0.069755 | 15.752 | **1.2087e-38** |
|  | Un. | -0.003363 | 0.021714 | -0.155 | 0.8769 |

Ac. – *Acanthoparyphium* sp., Ma. – *M. novaezealandensis*, Ph. – *Philophthalmus* sp., Un. – Uninfected

Table S4. Output for the linear model analysis of oxygen consumption rates of snails in each infection category in each trial. n=60 for each infection category. ‘Length’ represents the length of snail shells at the beginning of the 90 day trial. Significant P-values are shown in bold type.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  | **Trial 1** | **Trial 2** | **Trial 3** |
|  |  | **df** | **F** | **P** | **F** | **P** | **F** | **P** |
| **Uninfected** | **pH** | 2 | 10.78 | **<0.001** | 53.16 | **<0.001** | 6.43 | **0.003** |
|  | **length** | 1 | 3.10 | 0.083 | 0.85 | 0.360 | 0.09 | 0.759 |
|  | **residuals** | 56 |  |  |  |  |  |  |
| ***M. novaezealandensis*** | **pH** | 2 | 24.55 | **<0.001** | 16.71 | **<0.001** | 13.04 | **<0.001** |
|  | **length** | 1 | 16.73 | **<0.001** | 13.81 | **<0.001** | 17.74 | **<0.001** |
|  | **residuals** | 56 |  |  |  |  |  |  |
| ***Philophthalmus* sp.** | **pH** | 2 | 10.76 | **<0.001** | 7.62 | **0.001** | 6.17 | **0.004** |
|  | **length** | 1 | 2.07 | 0.156 | 0.16 | 0.687 | 1.81 | 0.184 |
|  | **residuals** | 56 |  |  |  |  |  |  |
| ***Acanthoparyphium* sp.** | **pH** | 2 | 0.312 | 0.733 | 15.96 | **<0.001** | 1.40 | 0.256 |
|  | **length** | 1 | 14.29 | **<0.001** | 5.49 | **0.023** | 11.42 | **0.001** |
|  | **residuals** | 56 |  |  |  |  |  |  |

**Table S5**. Post hoc analysis of differences in glucose concentration between pH treatments and within infection categories. Significant P-values are shown in bold type.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |   | **Estimate** | **SE** | **t-value** | **P-value** |
| ***Philophthalmus* sp.** | Intercept (pH 8.1) | 1.30833 | 0.19944 | 6.560 | **2.6967e-08** |
|  | pH 7.6 | 0.01032 | 0.05906 | 0.175 | 0.8617 |
|  | pH 7.4 | -0.09373 | 0.05964 | -1.571 | 0.1223 |
|  | Intercept (pH 7.6) | 1.31865 | 0.19913 | 6.622 | **2.1526e-08** |
|  | pH 7.4 | 2.1526e-08 | 0.05891 | -1.766 | 0.0833 |
| ***M. novaezealandensis*** | Intercept (pH 8.1) | 0.0326217 | 0.0150346 | 2.170 | **0.0354** |
|  | pH 7.6 | -0.0001240 | 0.0040258 | -0.031 | 0.9754 |
|  | pH 7.4 | -0.0160442 | 0.0045049 | -3.561 | **0.0009** |
|  | Intercept (pH 7.6) | 0.0324977 | 0.0145215 | 2.238 | **0.0303** |
|  | pH 7.4 | -0.0159202 | 0.0045057 | -3.533 | **0.0010** |
| ***Acanthoparyphium* sp.** | Intercept (pH 8.1) | 2.21268 | 0.63910 | 3.462 | **0.0010** |
|  | pH 7.6 | 0.53186 | 0.15892 | 3.347 | **0.0015** |
|  | pH 7.4 | 0.47251 | 0.16305 | 2.898 | **0.0054** |
|  | Intercept (pH 7.6) | 2.74454 | 0.63651 | 4.312 | **7.2372e-05** |
|  | pH 7.4 | -0.05935 | 0.15896 | -0.373 | 0.7106 |
| **Uninfected** | Intercept (pH 8.1) | 0.602609 | 0.112858 | 5.340 | **1.3118e-06** |
|  | pH 7.6 | -0.065241 | 0.022313 | -2.924 | **0.0047** |
|  | pH 7.4 | 0.014658 | 0.020597 | 0.712 | 0.4790 |
|  | Intercept (pH 7.6) | 0.537368 | 0.110879 | 4.846 | **8.3637e-06** |
|  | pH 7.4 | 0.079899 | 0.021026 | 3.800 | **0.0003** |

**Table S6**. Post hoc analysis of differences in glucose concentration between infection categories and within pH treatments. Significant P-values are shown in bold type.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |   | **Estimate** | **SE** | **t-value** | **P-value** |
| **8.1 pH** | Intercept (Ac.) | 0.443187 | 0.058339 | 7.597 | **1.3936e-10** |
|  | Ma. | -0.038036 | 0.018395 | -2.068 | **0.0425** |
|  | Ph. | -0.076728 | 0.018820 | -4.077 | **0.0001** |
|  | Un. | -0.099752 | 0.019267 | -5.177 | **2.297e-06** |
|  | Intercept (Ma.) | 0.405150 | 0.058100 | 6.973 | **1.809e-09** |
|  | Ph. | -0.038692 | 0.018504 | -2.091 | **0.0403** |
|  | Un. | -0.061716 | 0.018950 | -3.257 | **0.0017** |
|  | Intercept (Ph.) | 0.366458 | 0.056541 | 6.481 | **1.341e-08** |
|  | Un. | -0.023024 | 0.019097 | -1.206 | 0.232 |
| **7.6 pH** | Intercept (Ac.) | 0.3393971 | 0.0607705 | 5.585 | **4.762e-07** |
|  | Ma. | 0.0257365 | 0.0171968 | 1.497 | 0.1391 |
|  | Ph. | -0.0093198 | 0.0166986 | -0.558 | 0.5787 |
|  | Un. | -0.0983806 | 0.0180672 | -5.445 | **8.2086e-07** |
|  | Intercept (Ma.) | 0.3651336 | 0.0592045 | 6.167 | **4.7535e-08** |
|  | Ph. | -0.0350563 | 0.0172843 | -2.028 | **0.0466** |
|  | Un. | -0.1241171 | 0.0184027 | -6.744 | **4.6092e-09** |
|  | Intercept (Ph.) | 0.3300773 | 0.0591614 | 5.579 | **4.8750e-07** |
|  | Un. | -0.0890608 | 0.0179592 | -4.959 | **5.2355e-06** |
| **7.4 pH** | Intercept (Ac.) | 1.28054 | 0.15587 | 8.216 | **1.3420e-11** |
|  | Ma. | 0.10558 | 0.04828 | 2.187 | **0.0324** |
|  | Ph. | -0.02384 | 0.04169 | -0.572 | 0.5693 |
|  | Un. | 0.06834 | 0.04082 | 1.674 | 0.0990 |
|  | Intercept (Ma.) | 1.38613 | 0.14382 | 9.638 | **4.4173e-14** |
|  | Ph. | -0.12942 | 0.04709 | -2.748 | **0.0077** |
|  | Un. | -0.03725 | 0.04521 | -0.824 | 0.4129 |
|  | Intercept (Ph.) | 1.25670 | 0.15091 | 8.327 | **8.5585e-12** |
|  | Un. | 0.09218 | 0.04004 | 2.302 | **0.0245** |

Ac. – *Acanthoparyphium* sp., Ma. – *M. novaezealandensis*, Ph. – *Philophthalmus* sp., Un. – Uninfected

**Table S7.** Output for the linear mixed effect analysis of oxygen consumption rates that pooled all infected snails ‘Infected vs uninfected’ and pooled all snails ‘No infection’. ‘Length’ represents the length of snail shells at the beginning of the 90 day trial. Significant P-values are shown in bold type.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | **df** | **MS** | **F** | **P** |
| **Infected vs uninfected** | pH | 2 | 0.14329 | 9.2144 | **<0.001** |
|  | Infection | 1 | 0.01386 | 0.8912 | 0.345 |
|  | Length | 1 | 0.68755 | 44.2145 | **<0.001** |
|  | pH\*infection | 2 | 0.06847 | 4.4029 | **0.012** |
|  | pH\*length | 2 | 0.03428 | 2.2047 | 0.111 |
|  | Infection\*length | 1 | 0.02313 | 1.4874 | 0.223 |
|  | pH\*infection\*length | 2 | 0.04149 | 2.6682 | 0.070 |
| **No infection** | pH | 2 | 0.11659 | 7.4778 | **<0.001** |
|  | Length | 1 | 0.64271 | 41.2218 | **<0.001** |
|  | pH\*length | 2 | 0.03902 | 2.5025 | 0.083 |

**Table S8**. Intra-class correlation (ICC) scores of all data subsets used in all trials showing the percent repeatability of data generated by snails maintained in the same chamber (Chamber ID).

|  |  |  |
| --- | --- | --- |
|  | **Oxygen** **(%)** | **Glucose (%)** |
| **Overall** | 11 | 13 |
| **8.1 pH** | 5 | 13 |
| **7.6 pH** | 14 | 3 |
| **7.4 pH** | 21 | 1 |
| **Uninfected** | 10 | 4 |
| ***Acanthoparyphium* sp.**  | 22 | 1 |
| ***Philophthalmus* sp.** | 21 | 6 |
| ***M. novaezealandensis*** | 8 | 10 |

**Table S9** Output for the linear mixed effect analysis of glucose concentration that pooled all infected snails ‘Infected vs uninfected’ and pooled all snails ‘No infection’. Note: ‘Length’ was removed from the glucose analysis during model selection . Significant P-values are shown in bold type.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | **df** | **MS** | **F** | **P** |
| **Infected vs uninfected** | pH | 2 | 0.0107 | 3.672 | **0.027** |
|  | Infection | 1 | 0.0894 | 30.462 | **<0.001** |
|  | pH\*infection | 2 | 0.0139 | 4.764 | **0.009** |
| **No infection** | pH | 2 | 0.0072 | 2.426 | 0.091 |