# Results

## Somatic growth and survival rates

The provision of different dietary (f: formulated, k: kelp, m: mixed, u: ulva) and temperature (a: ambient, w: warm) treatments had a significant impact on the specific growth rate (SGR) (%) in terms of the wet weight of the whole urchin (SGRweight) and the size of the urchin test diameter (SGRdiam). The influence of different dietary treatments significant impacted SGRweight after 4 weeks (F = 38.23, df = 3, p < 0.001, Figure \*). A post hoc Tukey test showed that in week 4 the formulated dietary treatment group, which had the fastest SGRweight (mean ± se) (fa: 0.23 ± 0.03 %; fw: 0.20 ± 0.02 %), and the kelp dietary treatment group, which had the slowest SGRweight (mean ± se) (ka: -0.03 ± 0.03 %; kw: -0.10 ± 0.04%), were significantly different to one another and to the other dietary treatment groups. The negative SGRweight values for the kelp dietary treatment group indicated that, on average, the urchins fed kelp had lost weight over the first 4 weeks of the experiment. There was a significant increase in SGRweight for the kelp diet and warm temperature (kw) treatment group between week 4 and week 8 (kwweek8: 0.18 ± 0.09%) such that by week 8 there were no longer significant differences in SGRweight between dietary (F = 1.97, df = 3, p-value >0.05) or temperature (F = 2.91, df = 1, p-value > 0.05) treatment groups. Numerous urchins in the kelp dietary treatment group presented severe spine loss (Figure 1\*) and were therefore removed from the tanks and euthanized as a result of poor health and the impact it may have on the other urchins in the tank and overall water quality.

Significant differences in survival rates were found between dietary treatments after 9 weeks (χ2= 20.332, df = 3, p-value < 0.001). A post hoc Dunn’s test showed that after 9 weeks, due to the high degree of unhealthy urchins within the kelp dietary treatment, the kelp dietary treatment had a significantly lower survival rate than all other dietary treatment groups (mean ± se) (ka: 67.11 ± 6.58%; kw: 65.79 ± 6.26%) at p < 0.05. Due to animal ethics concerns, the kelp dietary treatment was suspended after week 9, all urchins subjected to the kelp dietary treatment were removed from the experiment and euthanized. Kelp was also removed from the mixed dietary treatment feeding regime, changing the regime to a rotation of *Ulva* and formulated feed on a weekly basis from week 10 onwards.

After the removal of kelp from the mixed dietary treatment feeding regime there was a significant increase in SGRdiam (ma: t = -8.611, df = 2,…) by week 13.

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| Week | Diet | Temperature | Treatment | SGRweight (%)  (mean ± se) | SGRdiam (%)  (mean ± se) | Survival rate (%)  (mean ± se) |
| 4 | formulated | ambient | fa | 0.24 ± 0.03 | 0.25 ± 0.12 | 100.00 ± 0.00 |
| 4 | formulated | warm | fw | 0.20 ± 0.02 | -0.01 ± 0.02 | 100.00 ± 0.00 |
| 4 | mixed | ambient | ma | 0.12 ± 0.03 | 0.12 ± 0.06 | 100.00 ± 0.00 |
| 4 | mixed | warm | mw | 0.10 ± 0.04 | -0.09 ± 0.06 | 100.00 ± 0.00 |
| 4 | ulva | ambient | ua | 0.05 ± 0.02 | 0.03 ± 0.04 | 98.68 ± 1.32 |
| 4 | ulva | warm | uw | 0.14 ± 0.03 | 0.01 ± 0.04 | 100.00 ± 0.00 |
| 4 | kelp | ambient | ka | -0.03 ± 0.03 | 0.00 ± 0.03 | 100.00 ± 0.00 |
| 4 | kelp | warm | kw | -0.10 ± 0.04 | 0.08 ± 0.15 | 100.00 ± 0.00 |
| 8 | formulated | ambient | fa | 0.37 ± 0.00 | 0.08 ± 0.02 | 92.11 ± 3.40 |
| 8 | formulated | warm | fw | 0.23 ± 0.05 | 0.14 ± 0.11 | 98.68 ± 1.32 |
| 8 | mixed | ambient | ma | 0.32 ± 0.03 | -0.02 ± 0.06 | 97.37 ± 2.63 |
| 8 | mixed | warm | mw | 0.26 ± 0.04 | 0.16 ± 0.04 | 100.00 ± 0.00 |
| 8 | ulva | ambient | ua | 0.27 ± 0.06 | 0.06 ± 0.05 | 88.16 ± 3.95 |
| 8 | ulva | warm | uw | 0.16 ± 0.03 | 0.10 ± 0.09 | 98.68 ± 1.32 |
| 8 | kelp | ambient | ka | 0.15 ± 0.09 | 0.05 ± 0.08 | 76.32 ± 8.18 |
| 8 | kelp | warm | kw | 0.18 ± 0.09 | -0.00 ± 0.09 | 76.32 ± 8.18 |
| 13 | formulated | ambient | fa | 0.20 ± 0.01 | 0.18 ± 0.05 | 90.79 ± 3.31 |
| 13 | formulated | warm | fw | 0.09 ± 0.03 | 0.11 ± 0.06 | 98.68 ± 1.32 |
| 13 | mixed | ambient | ma | 0.30 ± 0.03 | 0.33 ± 0.05 | 93.42 ± 6.58 |
| 13 | mixed | warm | mw | 0.22 ± 0.03 | 0.30 ± 0.04 | 98.68 ± 1.32 |
| 13 | ulva | ambient | ua | 0.25 ± 0.03 | 0.23 ± 0.08 | 84.21 ± 5.26 |
| 13 | ulva | warm | uw | 0.14 ± 0.02 | 0.14 ± 0.07 | 98.68 ± 1.32 |
| 18 | formulated | ambient | fa | 0.11 ± 0.07 | -0.03 ± 0.03 | 88.16 ± 4.49 |
| 18 | formulated | warm | fw | -0.02 ± 0.06 | -0.04 ± 0.03 | 98.68 ± 1.32 |
| 18 | mixed | ambient | ma | 0.27 ± 0.05 | -0.03 ± 0.03 | 90.79 ± 7.56 |
| 18 | mixed | warm | mw | 0.19 ± 0.03 | -0.02 ± 0.04 | 98.68 ± 1.32 |
| 18 | ulva | ambient | ua | 0.17 ± 0.04 | 0.04 ± 0.03 | 81.58 ± 4.59 |
| 18 | ulva | warm | uw | 0.15 ± 0.05 | 0.07 ± 0.04 | 97.37 ± 2.63 |
| 23 | formulated | ambient | fa | -0.00 ± 0.02 | 0.15 ± 0.03 | 85.53 ± 5.84 |
| 23 | formulated | warm | fw | 0.04 ± 0.03 | 0.06 ± 0.04 | 96.05 ± 2.52 |
| 23 | mixed | ambient | ma | 0.14 ± 0.01 | 0.18 ± 0.02 | 90.79 ± 7.56 |
| 23 | mixed | warm | mw | 0.18 ± 0.02 | 0.04 ± 0.03 | 98.68 ± 1.32 |
| 23 | ulva | ambient | ua | 0.03 ± 0.03 | 0.08 ± 0.05 | 81.58 ± 4.56 |
| 23 | ulva | warm | uw | 0.12 ± 0.05 | 0.06 ± 0.03 | 97.37 ± 2.63 |



