Supplementary Material

# Supplementary Figures and Tables

## Supplementary Figures

**Supplement figure 1.** Representation of PCAs on all compounds of (A) *F. fusca*, (B) *F. exsecta*, (C) *F. pressilabris*, and (D) *F. aquilonia* calculated from relative proportions of cuticular compounds extracted from larvae. Non-starved larvae are represented in orange and starved larvae are represented in blue. The circles represent the 95% confidence ellipse for each group.

**Supplement figure 2.** Representation of PCAs on cuticular alkanes of (A) *F. fusca*, (B) *F. exsecta*, (C) *F. pressilabris*, and (D) *F. aquilonia* calculated from relative proportions of cuticular compounds extracted from larvae. Non-starved larvae are represented in orange and starved larvae are represented in blue. The circles represent the 95% confidence ellipse for each group.

**Supplement figure 3.** Representation of PCAs on cuticular methylated alkanes of (A) *F. fusca*, (B) *F. exsecta*, (C) *F. pressilabris*, and (D) *F. aquilonia* calculated from relative proportions of cuticular compounds extracted from larvae. Non-starved larvae are represented in orange and starved larvae are represented in blue. The circles represent the 95% confidence ellipse for each group.

**Supplement figure 4.** Representation of PCAs on cuticular alkenes of (A) *F. fusca*, (B) *F. exsecta*, (C) *F. pressilabris*, and (D) *F. aquilonia* calculated from relative proportions of cuticular compounds extracted from larvae. Non-starved larvae are represented in orange and starved larvae are represented in blue. The circles represent the 95% confidence ellipse for each group.

## Supplementary Tables

**Supplement table 1.** Cuticular chemical compounds of *Formica* ant larvae. Unidentified compounds are named by letters.

|  |  |  |
| --- | --- | --- |
| Compounds | Retention time | Retention index |
| C23 | 16.243 | 2300 |
| C25:1 | 18.923 | 2477 |
| C25 | 19.263 | 2500 |
| Mix x-Me C25 | 19.753 | 2533 |
| 7-Me C25 | 19.843 | 2539 |
| 5-Me C25 | 19.980 | 2548 |
| A | 20.290 | 2569 |
| 3-Me C25 | 20.353 | 2573 |
| B  | 20.400 | 2576 |
| C | 21.173 | 2628 |
| D | 21.460 | 2647 |
| E  | 21.563 | 2655 |
| F | 21.783 | 2670 |
| C27:1 | 21.910 | 2679 |
| C27 | 22.220 | 2700 |
| 7-MeC27 | 22.780 | 2739 |
| 5-MeC27 | 22.913 | 2748 |
| G | 23.000 | 2754 |
| 3-MeC27 | 23.280 | 2774 |
| C29:1 | 24.777 | 2880 |
| C29 | 25.057 | 2900 |
| Mix x-Me C29 | 25.460 | 2930 |
| 7-MeC29 | 25.570 | 2938 |
| 5-MeC29 | 25.703 | 2948 |
| 11,x-DimeC29 | 25.863 | 2959 |
| H | 26.150 | 2980 |
| Mix x-Me C30 | 26.793 | 3029 |
| C31:2 | 27.417 | 3076 |
| C31:1 | 27.487 | 3081 |
| C31 | 27.727 | 3100 |
| Mix x-Me C31 | 28.087 | 3128 |
| 5-MeC31 | 28.347 | 3148 |
| 11,x-DimeC31 | 28.440 | 3155 |
| C32:1 | 28.793 | 3183 |
| C32 | 29.003 | 3199 |
| I | 29.340 | 3226 |
| J | 29.713 | 3254 |
| K | 29.903 | 3269 |
| C33:2 | 30.077 | 3283 |
| C33 | 30.303 | 3300 |
| Mix x-Me C33 | 30.677 | 3326 |
| 5-MeC33 | 30.990 | 3348 |
| 11,x-DimeC33 | 31.043 | 3352 |
| L | 31.347 | 3373 |
| C35:1 | 33.097 | 3484 |
| C35 | 33.360 | 3500 |

**Supplement table 2.** Results of Generalized Linear Mixed Models using Template Model Builder linking the duration of swaying movements to the state of the larvae, intra-colony relatedness, and intra-colony sex ratio for each species separately. Significant p-values are written in bold. n represents the number of starved and non-starved larvae used in each model.

|  |  |  |
| --- | --- | --- |
| Swaying duration |  ~ **relatedness**\*state+(1|group) |  ~ **sex ratio**\*state+(1|group) |
| *F. fusca* (n=172) | Effect | b±SE | z  | p-value | Effect | b±SE | z  | p-value |
| relatedness | -4.24±2.45 | -1.73 | 0.084 | sex ratio | 0.80±5.14 | 0.16 | 0.876 |
| state  | -0.54±0.73 | -0.73 | 0.464 | state | 0.28±0.75 | 0.37 | 0.710 |
| relatedness:state | 4.79±2.60 | 1.84 | 0.065 | sex ratio:state | 0.02±5.29 | 0.003 | 0.998 |
| Random variable | Var±SD |  |   | Random variable | Var±SD |  |  |
| (1|group) | 1.36±1.17 |  |   | (1|group) | 1.47±1.21 |  |  |
| *F. exsecta* (n=129) | Effect | b±SE | z  | p-value | Effect | b±SE | z  | p-value |
| relatedness | -1.39±13.05 | -0.11 | 0.915 | sex ratio | 17.20±25.16 | 0.68 | 0.494 |
| state  | 12.99±2.75 | 4.72 | **<0.001** | state | 15.79±2.49 | 6.35 | **<0.001** |
| relatedness:state | -10.81±16.84 | -0.64 | 0.521 | sex ratio:state | -47.66±26.48 | -1.80 | 0.072 |
| Random variable | Var±SD |  |   | Random variable | Var±SD |  |  |
| (1|group) | 78.01±8.83 |  |   | (1|group) | 41.12±6.41 |  |  |
| *F. pressilabris* (n=172) | Effect | b±SE | z  | p-value | Effect | b±SE | z  | p-value |
| relatedness | -1.94±1.60 | -1.21 | 0.226 | sex ratio | 0.70±2.74 | 0.25 | 0.800 |
| state  | 0.24±0.37 | 0.65 | 0.514 | state | 0.69±0.45 | 1.55 | 0.122 |
| relatedness:state | 3.45±2.16 | 1.60 | 0.109 | sex ratio:state | -4.38±3.61 | -1.21 | 0.225 |
| Random variable | Var±SD |  |   | Random variable | Var±SD |  |  |
| (1|group) | 0.98±0.99 |  |   | (1|group) | 0.98±0.99 |  |  |
| *F. aquilonia* (n=168) | Effect | b±SE | z  | p-value | Effect | b±SE | z  | p-value |
| relatedness | 0.26±2.15 | 0.12 | 0.905 | sex ratio | 6.76±2.44 | 2.78 | **0.006** |
| state  | -0.54±0.57  | -0.94 | 0.347 | state | 0.74±0.58 | 1.29 | 0.197 |
| relatedness:state | 0.64±2.59 | 0.25 | 0.804 | sex ratio:state | -9.14±2.87 | -3.18 | **0.002** |
| Random variable | Var±SD |  |   | Random variable | Var±SD |  |  |
| (1|group) | 1.48±1.22 |   |   | (1|group) | 1.08±1.04 |   |   |

**Supplement table 3.** Results of Generalized Linear Mixed Models using Template Model Builder linking the number of mandible movements to the state of the larvae, intra-colony relatedness, and intra-colony sex ratio for each species separately. Significant p-values are written in bold. n represents the number of starved and non-starved larvae used in each model.

|  |  |  |
| --- | --- | --- |
| Number of mandible movements |  ~ **relatedness**\*state+(1|group) |  ~ **sex ratio**\*state+(1|group) |
| *F. fusca* (n=172) | Effect | b±SE | z  | p-value | Effect | b±SE | z  | p-value |
| relatedness | -4.58±2.15 | -2.14 | **0.033** | sex ratio | -0.05±2.83 | -0.02 | 0.985 |
| state  | -0.21±0.33 | -0.62 | 0.533 | state | 0.01±0.38 | 0.02 | 0.988 |
| relatedness:state | 4.99±2.25 | 2.22 | **0.027** | sex ratio:state | 0.16±3.01 | 0.05 | 0.958 |
| Random variable | Var±SD |  |   | Random variable | Var±SD |  |  |
| (1|group) | 0.21±0.46 |  |   | (1|group) | 0.26±0.51 |  |  |
| *F. exsecta* (n=129) | Effect | b±SE | z  | p-value | Effect | b±SE | z  | p-value |
| relatedness | 4.02±2.38 | 1.69 | 0.091 | sex ratio | -3.86±2.80 | -1.38 | 0.168 |
| state  | 0.64±0.34 | 1.88 | 0.061 | state | 0.35±0.34 | 1.03 | 0.304 |
| relatedness:state | -5.44±2.56 | -2.12 | **0.034** | sex ratio:state | 0.95±3.08 | 0.31 | 0.759 |
| Random variable | Var±SD |  |   | Random variable | Var±SD |  |  |
| (1|group) | 0.37±0.61 |  |   | (1|group) | 0.33±0.58 |  |  |
| *F. pressilabris* (n=172) | Effect | b±SE | z  | p-value | Effect | b±SE | z  | p-value |
| relatedness | -2.33±1.00 | -2.31 | **0.021** | sex ratio | 2.66±1.70 | 1.56 | 0.119 |
| state  | 0.18±0.23 | 0.75 | 0.251 | state | 0.29±0.28 | 1.06 | 0.287 |
| relatedness:state | 1.14±1.29 | 0.88 | 0.379 | sex ratio:state | -2.26±2.28 | -0.99 | 0.321 |
| Random variable | Var±SD |  |   | Random variable | Var±SD |  |  |
| (1|group) | 0.19±0.43 |  |   | (1|group) | 0.18±0.43 |  |  |
| *F. aquilonia* (n=168) | Effect | b±SE | z  | p-value | Effect | b±SE | z  | p-value |
| relatedness | -2.42±0.90 | -2.69 | **0.007** | sex ratio | 0.12±1.49 | 0.08 | 0.937 |
| state  | -0.93±0.32 | -2.90 | **0.004** | state | -0.16±0.40 | -0.39 | 0.695 |
| relatedness:state | 3.79±1.20 | 3.15 | **0.002** | sex ratio:state | -0.72±1.83 | -0.39 | 0.696 |
| Random variable | Var±SD |  |   | Random variable | Var±SD |  |  |
| (1|group) | 0.25±0.50 |   |   | (1|group) | 0.44±0.66 |   |   |

**Supplement table 4.** Results of Generalized Linear Mixed Models using Template Model Builder linking the duration of mandible movements to the state of the larvae, intra-colony relatedness, and intra-colony sex ratio for each species separately. Significant p-values are written in bold. n represents the number of starved and non-starved larvae used in each model.

|  |  |  |
| --- | --- | --- |
| Mandible movement duration |  ~ **relatedness**\*state+(1|group) |  ~ **sex ratio**\*state+(1|group) |
| *F. fusca* (n=172) | Effect | b±SE | z  | p-value | Effect | b±SE | z  | p-value |
| relatedness | -27.93±13.22 | -2.11 | **0.035** | sex ratio | -10.53±17.96 | -0.59 | 0.558 |
| state  | -2.93±2.44 | -1.20 | 0.229 | state | -1.67±2.79 | -0.62 | 0.536 |
| relatedness:state | 30.12±13.92 | 2.16 | **0.031** | sex ratio:state | 14.16±19.11 | 0.74 | 0.459 |
| Random variable | Var±SD |  |   | Random variable | Var±SD |  |  |
| (1|group) | 36.92±6.08 |  |   | (1|group) | 41.07±6.41 |  |  |
| *F. exsecta* (n=129) | Effect | b±SE | z  | p-value | Effect | b±SE | z  | p-value |
| relatedness | 1.09±3.50 | 0.312 | 0.755 | sex ratio | 3.43±3.10 | 1.11 | 0.268 |
| state  | 0.77±0.48 | 1.60 | 0.111 | state | 0.64±0.45 | 1.41 | 0.158 |
| relatedness:state | -1.27±3.74 | -0.34 | 0.735 | sex ratio:state | -0.70±3.48 | -0.20 | 0.842 |
| Random variable | Var±SD |  |   | Random variable | Var±SD |  |  |
| (1|group) | 1.34±1.16 |  |   | (1|group) | 1.19±1.09 |  |  |
| *F. pressilabris* (n=172) | Effect | b±SE | z  | p-value | Effect | b±SE | z  | p-value |
| relatedness | -8.28±6.50 | -1.28 | 0.202 | sex ratio | 9.51±11.50 | 0.82 | 0.412 |
| state  | 1.65±1.42 | 1.17 | 0.243 | state | 2.83±1.63 | 1.74 | 0.083 |
| relatedness:state | 6.96±8.64 | 0.81 | 0.420 | sex ratio:state | -14.05±14.74 | -0.96 | 0.340 |
| Random variable | Var±SD |  |   | Random variable | Var±SD |  |  |
| (1|group) | 19.28±4.39 |  |   | (1|group) | 20.04±4.48 |  |  |
| *F. aquilonia* (n=168) | Effect | b±SE | z  | p-value | Effect | b±SE | z  | p-value |
| relatedness | -0.62±4.92 | -1.26 | 0.209 | sex ratio | -0.55±1.84 | -0.30 | 0.764 |
| state  | 1.64±1.85 | 0.88 | 0.377 | state | 0.04±0.48 | 0.09 | 0.93 |
| relatedness:state | 4.19±6.30 | 0.67 | 0.506 | sex ratio:state | -1.26±2.19 | -0.57 | 0.556 |
| Random variable | Var±SD |  |   | Random variable | Var±SD |  |  |
| (1|group) | 16.08±4.01 |   |   | (1|group) | 0.94±0.97 |   |   |

**Supplement table 5.** Results of Generalized Linear Mixed Models using Template Model Builder linking the number of swaying movements, swaying duration, number of mandible movements or mandible movement duration to the state and species of the larvae, intra-colony relatedness, and intra-colony sex ratio. The five colonies for which we used mean species-level relatedness and sex ratio values were removed from the analyses. Significant p-values are written in bold. n represents the number of starved and non-starved larvae used in each model.

|  |  |  |
| --- | --- | --- |
|   |  ~ **relatedness**\*state+species+(1|group) |  ~ **sex ratio**\*state+species+(1|group) |
| Number of swaying movements (n=594) | Effect | Chisq | df | p-value | Effect | Chisq | df | p-value |
| relatedness | 2 219 | 1 | 0.136 | sex ratio | 0.118 | 1 | 0.732 |
| state | 1.217 | 1 | 0.270 | state | 3.814 | 1 | **0.051** |
| species | 1.003 | 3 | 0.801 | species | 0.271 | 3 | 0.965 |
| relatedness:state | 2.310 | 1 | 0.129 | sex ratio:state | 3.144 | 1 | 0.076 |
| Random variable | Var±SD |  |   | Random variable | Var±SD |  |  |
| (1|group) | 0.76±0.87 |   |   | (1|group) | 0.44±0.66 |   |   |
| Swaying duration (n=594) | Effect | Chisq | df | p-value | Effect | Chisq | df | p-value |
| relatedness | 1.744 | 1 | 0.187 | sex ratio | 0.003 | 1 | 0.960 |
| state | 22.580 | 1 | **<0.001** | state | 0.165 | 1 | 0.685 |
| species | 13.612 | 3 | **0.003** | species | 6.953 | 3 | 0.073 |
| relatedness:state | 0.728 | 1 | 0.394 | sex ratio:state | 4.894 | 1 | **0.027** |
| Random variable | Var±SD |  |   | Random variable | Var±SD |  |  |
| (1|group) | 30.54±5.53 |  |   | (1|group) | 1.21±1.10 |  |  |
| Number of mandible movements (n=594) | Effect | Chisq | df | p-value | Effect | Chisq | df | p-value |
| relatedness | 3.770 | 1 | 0.052 | sex ratio | 1.047 | 1 | 0.306 |
| state | 0.017 | 1 | 0.896 | state | 0.028 | 1 | 0.868 |
| species | 8.440 | 3 | **0.038** | species | 6.580 | 3 | 0.087 |
| relatedness:state | 5.866 | 1 | **0.015** | sex ratio:state | 2.086 | 1 | 0.149 |
| Random variable | Var±SD |  |   | Random variable | Var±SD |  |  |
| (1|group) | 0.28±0.53 |  |   | (1|group) | 0.30±0.55 |  |  |
| Mandible movement duration (n=594) | Effect | Chisq | df | p-value | Effect | Chisq | df | p-value |
| relatedness | 0.506 | 1 | 0.477 | sex ratio | 0.463 | 1 | 0.496 |
| state | 1.880 | 1 | 0.170 | state | 1.384 | 1 | 0.239 |
| species | 10.690 | 3 | **0.014** | species | 8.475 | 3 | **0.037** |
| relatedness:state | 6.680 | 1 | **0.010** | sex ratio:state | 0.895 | 1 | 0.344 |
| Random variable | Var±SD |  |   | Random variable | Var±SD |  |  |
| (1|group) | 1.15±1.07 |   |   | (1|group) | 1.20±1.10 |   |   |

**Supplement table 6.** Results of Generalized Linear Mixed Models using Template Model Builder linking the number of swaying movements to the state of the larvae, intra-colony relatedness, and intra-colony sex ratio for each species separately. The five colonies for which we used mean species-level relatedness and sex ratio values were removed from the analyses. Significant p-values are written in bold. n represents the number of starved and non-starved larvae used in each model.

|  |  |  |
| --- | --- | --- |
| Number of swaying movements |  ~ **relatedness**\*state+(1|group) |  ~ **sex ratio**\*state+(1|group) |
| *F. fusca* (n=156) | Effect | ±SE | z  | p-value | Effect | ±SE | z  | p-value |
| relatedness | 1.78±1.91 | 0.93 | 0.353 | sex ratio | 0.32±4.09 | 0.08 | 0.938 |
| state  | 1.71±0.59 | 2.90 | **0.004** | state | 1.49±0.60 | 2.49 | **0.013** |
| relatedness:state | -0.77±1.98 | -0.39 | 0.697 | sex ratio:state | 1.16±4.15 | 0.28 | 0.779 |
| Random variable | Var±SD |  |   | Random variable | Var±SD |  |  |
| (1|group) | 8.08\*10-9±8.99\*10-5 |   | (1|group) | 4.79\*10-9±6.92\*10-5 |  |
| *F. exsecta* (n=121) | Effect | ±SE | z  | p-value | Effect | ±SE | z  | p-value |
| relatedness | -1.28±5.42 | -0.24 | 0.813 | sex ratio | 3.85±5.17 | 0.75 | 0.457 |
| state  | 1.65±0.67 | 2.46 | **0.014** | state | 2.06±0.78 | 2.63 | **0.009** |
| relatedness:state | -2.13±5.69 | -0.37 | 0.709 | sex ratio:state | -8.17±5.74 | -1.42 | 0.154 |
| Random variable | Var±SD |  |   | Random variable | Var±SD |  |  |
| (1|group) | 1.06±1.03 |  |   | (1|group) | 1.24±1.11 |  |  |
| *F. pressilabris* (n=164) | Effect | ±SE | z  | p-value | Effect | ±SE | z  | p-value |
| relatedness | -0.96±1.21 | -0.80 | 0.426 | sex ratio | 0.35±1.89 | 0.19 | 0.853 |
| state  | -0.23±0.31 | -0.76 | 0.446 | state | -0.28±0.38 | -0.75 | 0.451 |
| relatedness:state | -1.44±1.65 | -0.87 | 0.382 | sex ratio:state | 1.12±2.66 | 0.42 | 0.673 |
| Random variable | Var±SD |  |   | Random variable | Var±SD |  |  |
| (1|group) | 0.10±0.31 |  |   | (1|group) | 0.06±0.24 |  |  |
| *F. aquilonia* (n=153) | Effect | ±SE | z  | p-value | Effect | ±SE | z  | p-value |
| relatedness | -5.36±1.85 | -2.89 | **0.004** | sex ratio | 7.61±1.48 | 5.13 | **<0.001** |
| state  | -1.44±0.56 | -2.56 | **0.010** | state | 0.12±0.47 | 0.25 | 0.801 |
| relatedness:state | 4.25±2.33 | 1.82 | 0.068 | sex ratio:state | -8.13±1.98 | -4.11 | **<0.001** |
| Random variable | Var±SD |  |   | Random variable | Var±SD |  |  |
| (1|group) | 0.89±0.95 |   |   | (1|group) | 0.12±0.34 |   |   |

**Supplement table 7.** Results of Generalized Linear Mixed Models using Template Model Builder linking the duration of swaying movements to the state of the larvae, intra-colony relatedness, and intra-colony sex ratio for each species separately. The five colonies for which we used mean species-level relatedness and sex ratio values were removed from the analyses. Significant p-values are written in bold. n represents the number of starved and non-starved larvae used in each model.

|  |  |  |
| --- | --- | --- |
| Swaying duration |  ~ **relatedness**\*state+(1|group) |  ~ **sex ratio**\*state+(1|group) |
| *F. fusca* (n=156) | Effect | b±SE | z  | p-value | Effect | b±SE | z  | p-value |
| relatedness | -4.24±2.46 | -1.72 | 0.086 | sex ratio | 0.73±5.18 | 0.14 | 0.888 |
| state  | -0.50±0.74 | -0.68 | 0.494 | state | 0.30±0.75 | 0.40 | 0.691 |
| relatedness:state | 4.77±2.62 | 1.82 | 0.068 | sex ratio:state | 0.08±5.33 | 0.02 | 0.988 |
| Random variable | Var±SD |  |   | Random variable | Var±SD |  |  |
| (1|group) | 1.38±1.17 |  |   | (1|group) | 1.49±1.22 |  |  |
| *F. exsecta* (n=121) | Effect | b±SE | z  | p-value | Effect | b±SE | z  | p-value |
| relatedness | -1.40±12.99 | -0.11 | 0.914 | sex ratio | 10.26±21.22 | 0.48 | 0.629 |
| state  | 13.25±2.78 | 4.77 | **<0.001** | state | 15.44±2.73 | 5.66 | **<0.001** |
| relatedness:state | -10.18±16.69 | -0.61 | 0.542 | sex ratio:state | -40.12±23.87 | -1.68 | 0.093 |
| Random variable | Var±SD |  |   | Random variable | Var±SD |  |  |
| (1|group) | 76.66±8.76 |  |   | (1|group) | 58.5±7.65 |  |  |
| *F. pressilabris* (n=164) | Effect | b±SE | z  | p-value | Effect | b±SE | z  | p-value |
| relatedness | -1.30±1.52 | -0.86 | 0.391 | sex ratio | 10.57±16.99 | 0.62 | 0.534 |
| state  | 0.05±0.35 | 0.15 | 0.877 | state | -0.24±2.61 | -0.09 | 0.927 |
| relatedness:state | 2.58±2.05 | 1.26 | 0.207 | sex ratio:state | -3.97±21.84 | -0.18 | 0.856 |
| Random variable | Var±SD |  |   | Random variable | Var±SD |  |  |
| (1|group) | 0.85±0.92 |  |   | (1|group) | 43.05±6.56 |  |  |
| *F. aquilonia* (n=153) | Effect | b±SE | z  | p-value | Effect | b±SE | z  | p-value |
| relatedness | -29.59±8.93 | -3.31 | **<0.001** | sex ratio | -8.67±13.47 | -0.64 | 0.520 |
| state  | -2.72±3.05 | -0.89 | 0.374 | state | 1.56±3.31 | 0.47 | 0.638 |
| relatedness:state | 24.65±10.98 | 2.25 | **0.025** | sex ratio:state | 3.50±15.81 | 0.22 | 0.825 |
| Random variable | Var±SD |  |   | Random variable | Var±SD |  |  |
| (1|group) | 43.28±6.58 |   |   | (1|group) | 46.66±6.83 |   |   |

**Supplement table 8.** Results of Generalized Linear Mixed Models using Template Model Builder linking the number of mandible movements to the state of the larvae, intra-colony relatedness, and intra-colony sex ratio for each species separately. The five colonies for which we used mean species-level relatedness and sex ratio values were removed from the analyses. Significant p-values are written in bold. n represents the number of starved and non-starved larvae used in each model.

|  |  |  |
| --- | --- | --- |
| Number of mandible movements |  ~ **relatedness**\*state+(1|group) |  ~ **sex ratio**\*state+(1|group) |
| *F. fusca* (n=156) | Effect | b±SE | z  | p-value | Effect | b±SE | z  | p-value |
| relatedness | -4.25±1.91 | -2.23 | **0.026** | sex ratio | 0.15±2.72 | 0.05 | 0.957 |
| state  | -0.08±0.30 | -0.25 | 0.800 | state | 0.11±0.35 | 0.30 | 0.762 |
| relatedness:state | 4.60±2.00 | 2.30 | **0.022** | sex ratio:state | -0.12±2.86 | -0.04 | 0.966 |
| Random variable | Var±SD |  |   | Random variable | Var±SD |  |  |
| (1|group) | 0.10±0.32 |  |   | (1|group) | 0.11±0.34 |  |  |
| *F. exsecta* (n=121) | Effect | b±SE | z  | p-value | Effect | b±SE | z  | p-value |
| relatedness | 3.81±1.98 | 1.93 | 0.054 | sex ratio | -4.64±2.39 | -1.95 | 0.052 |
| state  | 0.44±0.29 | 1.51 | 0.131 | state | 0.04±0.28 | 0.13 | 0.897 |
| relatedness:state | -5.58±2.14 | -2.60 | **0.009** | sex ratio:state | 1.71±2.63 | 0.65 | 0.516 |
| Random variable | Var±SD |  |   | Random variable | Var±SD |  |  |
| (1|group) | 0.17±0.41 |  |   | (1|group) | 0.07±0.27 |  |  |
| *F. pressilabris* (n=164) | Effect | b±SE | z  | p-value | Effect | b±SE | z  | p-value |
| relatedness | -2.46±1.07 | -2.29 | **0.022** | sex ratio | 2.65±1.75 | 1.52 | 0.129 |
| state  | 0.19±0.25 | 0.75 | 0.451 | state | 0.28±0.29 | 0.97 | 0.332 |
| relatedness:state | 1.19±1.36 | 0.87 | 0.383 | sex ratio:state | -2.24±2.33 | -0.96 | 0.338 |
| Random variable | Var±SD |  |   | Random variable | Var±SD |  |  |
| (1|group) | 0.21±0.46 |  |   | (1|group) | 0.20±0.45 |  |  |
| *F. aquilonia* (n=153) | Effect | b±SE | z  | p-value | Effect | b±SE | z  | p-value |
| relatedness | -2.57±0.89 | -2.88 | **0.004** | sex ratio | 0.51±1.45 | 0.35 | 0.726 |
| state  | -0.98±0.32 | -3.04 | **0.002** | state | -0.17±0.39 | -0.44 | 0.660 |
| relatedness:state | 3.88±1.18 | 3.28 | **0.001** | sex ratio:state | -1.07±1.79 | -0.60 | 0.552 |
| Random variable | Var±SD |  |   | Random variable | Var±SD |  |  |
| (1|group) | 0.24±0.49 |   |   | (1|group) | 0.40±0.63 |   |   |

**Supplement table 9.** Results of Generalized Linear Mixed Models using Template Model Builder linking the duration of mandible movements to the state of the larvae, intra-colony relatedness, and intra-colony sex ratio for each species separately. The five colonies for which we used mean species-level relatedness and sex ratio values were removed from the analyses. Significant p-values are written in bold. n represents the number of starved and non-starved larvae used in each model.

|  |  |  |
| --- | --- | --- |
| Mandible movement duration |  ~ **relatedness**\*state+(1|group) |  ~ **sex ratio**\*state+(1|group) |
| *F. fusca* (n=156) | Effect | b±SE | z  | p-value | Effect | b±SE | z  | p-value |
| relatedness | -6.44±3.39 | -1.90 | 0.057 | sex ratio | -0.69±3.72 | -0.19 | 0.853 |
| state  | 0.23±0.43 | 0.53 | 0.597 | state | 0.36±0.50 | 0.73 | 0.468 |
| relatedness:state | 6.68±3.47 | 1.93 | 0.054 | sex ratio:state | 1.03±3.89 | 0.264 | 0.792 |
| Random variable | Var±SD |  |   | Random variable | Var±SD |  |  |
| (1|group) | 1.01±1.01 |  |   | (1|group) | 1.11±1.06 |  |  |
| *F. exsecta* (n=121) | Effect | b±SE | z  | p-value | Effect | b±SE | z  | p-value |
| relatedness | 1.09±3.50 | 0.31 | 0.756 | sex ratio | 3.43±3.09 | 1.11 | 0.267 |
| state  | 0.73±0.48 | 1.50 | 0.134 | state | 0.60±0.46 | 1.32 | 0.189 |
| relatedness:state | -1.34±3.74 | -0.36 | 0.720 | sex ratio:state | -0.73±3.47 | -0.21 | 0.835 |
| Random variable | Var±SD |  |   | Random variable | Var±SD |  |  |
| (1|group) | 1.34±1.16 |  |   | (1|group) | 1.19±1.09 |  |  |
| *F. pressilabris* (n=164) | Effect | b±SE | z  | p-value | Effect | b±SE | z  | p-value |
| relatedness | -10.44±7.85 | -1.33 | 0.184 | sex ratio | 8.67±13.61 | 0.64 | 0.524 |
| state  | 1.43±1.68 | 0.85 | 0.395 | state | 2.45±1.97 | 1.25 | 0.213 |
| relatedness:state | 0.48±9.99 | 0.15 | 0.882 | sex ratio:state | -15.43±17.29 | -0.89 | 0.372 |
| Random variable | Var±SD |  |   | Random variable | Var±SD |  |  |
| (1|group) | 27.14±5.21 |  |   | (1|group) | 29.05±5.39 |  |  |
| *F. aquilonia* (n=153) | Effect | b±SE | z  | p-value | Effect | b±SE | z  | p-value |
| relatedness | -9.45±4.90 | -1.93 | 0.053 | sex ratio | -0.55±1.80 | -0.31 | 0.758 |
| state  | -1.10±1.81 | -0.61 | 0.545 | state | 0.07±0.47 | 0.15 | 0.878 |
| relatedness:state | 9.92±6.19 | 1.60 | 0.109 | sex ratio:state | -1.23±2.14 | -0.57 | 0.567 |
| Random variable | Var±SD |  |   | Random variable | Var±SD |  |  |
| (1|group) | 15.61±3.95 |   |   | (1|group) | 0.89±0.95 |   |   |