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Appendix S1: Details of Lab Experiments

Marianne Mugabo, Gwendolen M. Rodgers, Timothy G. Benton, Arpat Ozgul

Study organism

The *Sancassania berlesei* used in this experiment were taken from a laboratory stock culture that was originally collected from an agricultural manure heap in 2002. The life cycle of *S. Berlesei* consists of five stages: eggs, six-legged larvae, height-legged protonymphs, tritonymphs, and adults (Figure A1). Details regarding the biology of *S. Berlesei* and maintenance of stock culture can be found in Benton et al. (Benton, Lapsley & Beckerman 2001) and Plaistow & Benton (Plaistow & Benton 2009).

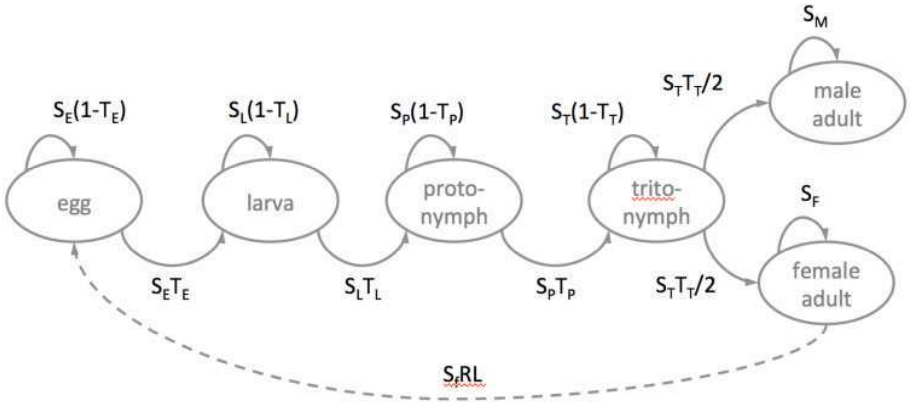

Figure A1. Life cycle graph for the soil mite with six life history stages: egg ($_E$), larvae ($_L$), protonymph ($_P$), tritonymph ($_T$), adult male ($_M$) and adult female ($_F$). S_x is the survival probability of an individual in stage x, T_x is the probability of an individual in stage x moving to the next stage conditional on survival, R is the probability of reproducing, and E is the number of eggs per reproducing female (reproduced from Ozgul et al. 2012).

Experimental design

Twenty-eight experimental populations were set up on the 27th of April 2012 with about 100 adults of each sex and 600-1000 juveniles collected from a laboratory stock culture. Populations were maintained at a constant food regime for 8 weeks prior the experiment until population dynamics and age structure were stabilized. All

21 populations were fed daily with 2 balls of dried yeast of standard size (1.58 mg ± 0.02, *n*
22 = 100) and watered with distilled water. On the first day of the experiment (i.e., after 8
23 weeks of setup), experimental populations were randomly assigned to one of 4 food
24 treatments: constant, famine, declining, and fluctuating. In the control treatment,
25 populations were maintained for 8 other weeks at a control daily food supply of two
26 balls of standard size (i.e., 3.16 mg daily in average). In the famine treatment,
27 populations were maintained at a control daily food supply for two other weeks before
28 experiencing a famine (i.e., no food supply) for the rest of the experiment until
29 population extinction (Figure 2). In the declining treatment, populations were fed daily
30 with a declining amount of food for 7 weeks before experiencing 3 weeks of famine. The
31 amount of food was reduced 3 times per week (Figure 2). In the fluctuating treatment,
32 populations received a high daily food supply for 2 weeks (i.e., 5.53 mg daily in average)
33 followed by 2 weeks of low daily food supply (i.e., 0.20 mg daily in average). This was
34 repeated for 4 more weeks. Populations then experienced a famine for 2 weeks (Figure
35 2).

36 In addition, on the first day of the experiment, five populations per treatment
37 were assigned to a population study (referred to as "counting populations") and two
38 populations per treatment were assigned to an individual study and a maternal effect
39 study (referred to as "sampling populations"). Counting populations were used to
40 monitor population dynamics, stage and sex structures and body size and egg size
41 dynamics. Sampling populations were used to monitor life-history traits (i.e., individual
42 body growth, survival, stage-transition, and fecundity) and maternal effects (i.e., the
43 relationship between the female environment and body size on one hand and egg size
44 and offspring development on the other hand). All populations were fed and watered at
45 12:00 noon each day from Monday to Sunday (Figure A2).

Population study

Counting populations were counted twice a week on Monday and Thursday or on Tuesday and Friday while sampling populations were counted once a week (Figure A2). The total numbers of adult males and females were counted over the all tube and the total numbers of eggs, larvae, protonymphs and tritonymphs were counted in a randomly selected quarter of the population tube then multiplied by four (Plaistow & Benton 2009). 8 normal resolution (1280 × 960 pixels), low magnification (× 2 magnification) photographs were taken of each tube (i.e., 2 photographs per tube quarter). From these photographs, 5 to 15 individuals of each stage were identified and measured for size for each population. Body size was measured as the distance from the tip of the hypostome to the tip of the opisthosoma and egg size was measured as the distance from tip to tip. Photographs were taken using a Nikon DS-5M camera mounted on a Nikon SMZ1500 stereo microscope and controlled by a Nikon DS-U1 connected to a PC. The Eclipsenet 1.20.0 software was used to take the photographs and the NIS-Elements D 3.2 software was used for size measurements.

Individual study

Individuals were sampled from "sampling populations" twice a week after feeding. Sampling occurred on Monday and Thursday for the first set of sampling tubes (i.e., S1 replicates, one population per treatment) and on Tuesday and Friday for the second set of sampling tubes (i.e., S2 replicates; Figure A2). Eight individual tubes were set up per sampling tube. Five individual tubes each contained one adult male and one adult female, and three tubes each contained one larva, one protonymph and one tritonymph. Sampled individuals were photographed at high magnification (× 4 for adults and × 6 for juveniles) upon sampling and were re-photographed after about 24 hours for body size measurements. Individuals were also checked for survival and

71 stage-transition. All quiescent individuals were kept for an additional 24 hours to
72 record body size after transition and sex (for quiescent tritonymphs only). Body size
73 measurements were made to measure daily growth. Female daily fecundity was
74 measured as the total number of eggs produced in adult individual tubes in the 24 hours
75 interval. All surviving individuals were then transferred back to their original
76 population tube. In a previous study, we demonstrated that sampling individuals from
77 populations for 19 hours had no substantial effects on the dynamics of populations
78 (Ozgul et al. 2012).
79 *Maternal effect study*
80 Female investment in offspring was assessed by estimating the size of up to 5
81 eggs per female sampled from S1 and S2 sampling populations. In addition, up to 5 eggs
82 per sampled female from S1 sampling populations were collected and placed separately
83 in individual tubes to follow juvenile development (Figure A2). Individual tubes were
84 monitored daily for survival and stage-transition until adulthood and individuals were
85 photographed after each observed transition for body size measurements.

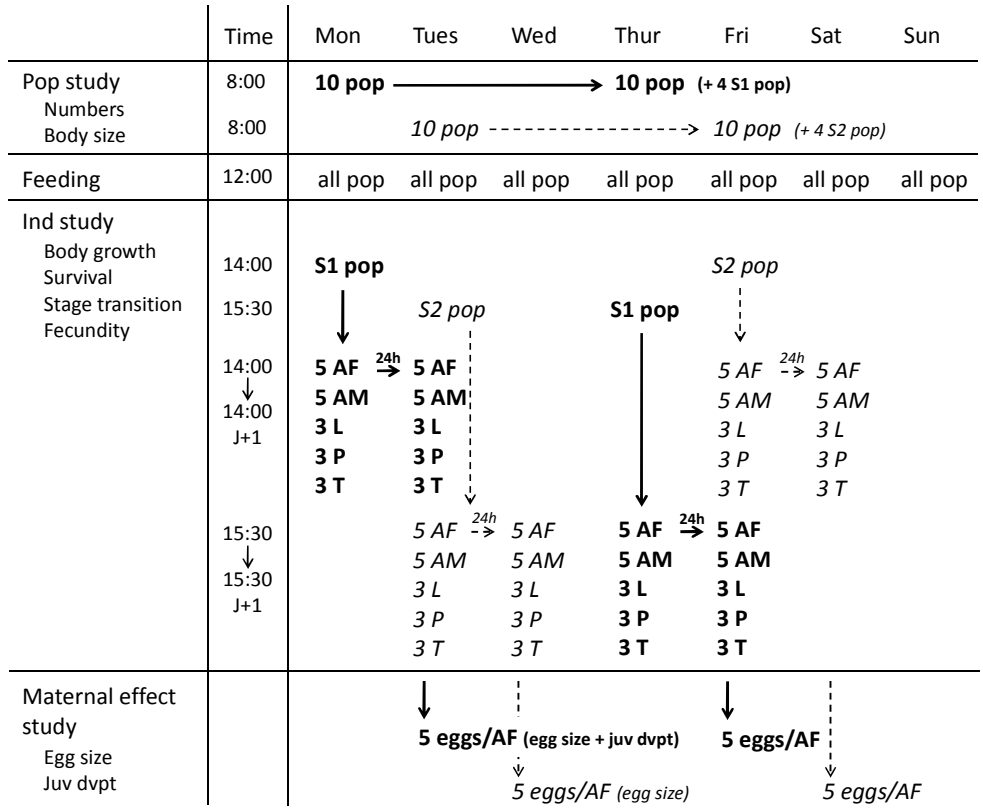

Figure A2. Daily timeline of the population (pop), individual (ind) and maternal effects studies. Each Monday and Thursday, 10 "counting populations" of all treatments were counted for numbers of males (M), females (F), larvae (L), protonymphs (P), tritonymphs (T) and egg (i.e., counting day 1). The other 10 "counting populations" were counted on Tuesday and Friday (i.e., counting day 2). "Sampling populations" (S1 and S2 populations for each treatment) were counted once a week (one Monday/Tuesday or on Thursday/Friday). Twice a week (i.e., on Monday/Thursday for S1 and on Tuesday/Friday for S2 replicates), 5 males and females and 3 larvae, protonymphs and tritonymphs were sampled for 24 hours from each sampling populations to measure life-history traits. After 24h, up to 5 eggs per sampled female were measured for egg size and eggs produced by sampled females from S1 populations were monitored throughout juvenile development until adulthood. Populations and

individuals in bold were monitored on Monday and Thursday every week. Populations and individual in italics were monitored on Tuesday and Friday every week.

Literature Cited

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