

Supporting information

Sex differences in alternative reproductive tactics in response to predation risk in tree crickets

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S1 Green lynx spiders are actively moving predators

We quantified how much *P. viridans* individuals move within a bush when a cricket is present on the bush at a time when tree crickets *Oecanthus henryi* are known to be active, 1900 hours to 2100 hours. Tree crickets and green lynx spiders were collected from near Ullodu village (13°38'27.2"N 77°42'01.1"E) in the Chikkaballapur district of Karnataka state in southern India. One spider and one cricket were released on a bush inside an enclosure in a semi-natural setting. The introduced spiders and crickets were alternately scan-sampled every 30 sec, for a total of 120 minutes from 1900 hours to 2100 hours. All movement decisions (change in direction relative to the previous location) were observed and after each experiment they were sequentially numbered on the bush. These points were then recorded as polar coordinates by measuring the height from the ground, as well as the distance and angle subtended between each tagged point from a fixed reference point. The reference point, common for all tagged points on a bush, was the centre of a fixed and levelled survey precision compass (Survey Compass 17475780, conceptualised by Francis Barker and Sons Ltd., sold and serviced by Lawrence and Mayo, India). The subtended angles were measured using the compass, and the distances and heights were measured using a metre tape. Euclidean distances between each change in direction was measured using a manually written code and added to get an estimate of how much each individual spider moved.

115 spiders were observed in 205 different experiments and the distance they moved ranged from 0 cm to 671.7 cm. They moved an average distance of $84.6 \text{ cm} \pm 104.5$ (Mean \pm SD), with spiders in only 11 out of 205 experiments not moving at all. Therefore, our careful observations

suggest that green lynx spiders are actively moving predators and not sit-and-wait predators when sampled nocturnally.

S2 Within-bush movement comparison between calling and non-calling males

We quantified how much *O. henryi* males move within a bush when they are calling and not calling to compare their movement pattern while exhibiting the two different mate searching behaviours. Distance moved by male crickets was measured using the same setup as the one explained in section S1.

41 calling males and 60 non-calling males were observed and the Euclidean distance they moved ranged from 0 cm to 213.2 cm and 0 cm to 305.76 cm, respectively. Calling males moved an average distance of 56.57 cm \pm 58.57 (Mean \pm SD), and non-calling males moved 46.68 cm \pm 58.70 (Mean \pm SD). The distance moved by calling and non-calling males was similar to each other ($P = 0.41$, permutation tests). Therefore, within a bush, males that call also move as much as males that do not call.

S3 Activity budgeting in tree crickets

We investigated activity budgeting in *O. henryi*, by observing and recording female cricket behaviour every 5 minutes between 1900 hours and 2100 hours (n = 6). These crickets were observed foraging and laying eggs 0% of the observed time. Majority of their time was spent staying still (60%), grooming (20%) and moving (13%).

S4 Details of statistical analysis

Mate searching behaviour

We analysed the effect of predation risk on mate searching, separately for male and female crickets. Distance moved by male and female crickets were non-normal continuous data that were zero-inflated and overdispersed. Thus, data were analysed using the zero-inflated negative binomial GLMM in the glmmTMB package (Brooks et al. 2017) in R. Since calling effort, likelihood of calling and likelihood of movement are proportions bounded between 0 and 1, binomial GLMMs were used to analyse the data using the lme4 package (Bates et al. 2014). Repeated observations of individual crickets were accounted for by including individual ID as a random effect. For all analyses, non-significant interaction terms ($P > 0.05$) were removed from the model.

Survival

We tested how survival changed with varying predation risk for each individual cricket over the duration of the experiment. To compare and interpret results of male and female crickets, survival of both were analysed in the same model. Whether survival was affected by varying predation risk depending on the sex of the cricket was tested by including a two-way interaction term. We ran a GLM assuming Poisson-distributed errors since survival data were non-normal counts with comparable mean and variance. Predation risk, the single predictor, was represented

by co-occurrence probabilities of individuals with spiders which were collated across the number of nights they survived.

Mating success

Mating success of individuals was analysed as a function of how long individuals survived and how they communicated. For male crickets, only calling effort and likelihood of movement were considered in the model, since including likelihood of calling and distance moved were collinear with the chosen variables (Zuur et al. 2009). For similar reasons, only distance moved was considered as an explanatory variable for females. GLM assuming Poisson-distributed errors were run because mating success data were non-normal counts. Since densities of crickets were not maintained through the duration of the experiment, potential effects of resultant differential encounter probabilities between the sexes were tested in the model and dropped when found to be not significant.

S5 Code for validating satellite behaviour using simulations

We explored what drives movement in males by investigating whether their movement implied satellite behaviour. We employed simulations to better understand whether male movement was directed towards calling males. The code written in R software is made available at https://github.com/torsay/predation_risk_mate_searching/blob/master/satellite_simulations

S6 Discrepancy between individual-level and population-level male calling effort responses to predation risk

The differential survival analysis results suggest that although most crickets in high predation treatment are co-occurring with predators, the mean calling effort of the male population in high predation treatment is not lower than that in no predation treatment. We investigated this pattern further to better understand the discrepancy between individual-level and population-level male calling effort responses to predation risk. We first ran the individual-level analysis (whether calling effort per individual per night changes according to predation risk experienced by the individual) separately for low and high predation treatments. We found that the overall pattern holds for both treatments: calling effort of individual male crickets per night reduces with increasing predation risk (Low predation treatment: $\chi^2 = 32.155$, $P < 0.001$; High predation treatment: $\chi^2 = 53.787$, $P < 0.001$) suggesting that this pattern was not due to treatment effects. But, we found the mean calling effort of individual males when not experiencing predation risk (POC = 0) in the high predation treatment (N = 17) is higher than that of individuals males not experiencing predation risk (POC = 0) in the low predation treatment (N = 129; permutation test, $P = 0.005$). This suggests that males not experiencing predation risk in high predation treatment may be compensating for the reduced calling effort of most other males that are experiencing predation risk such that the overall mean calling effort of the population is comparable across treatments.

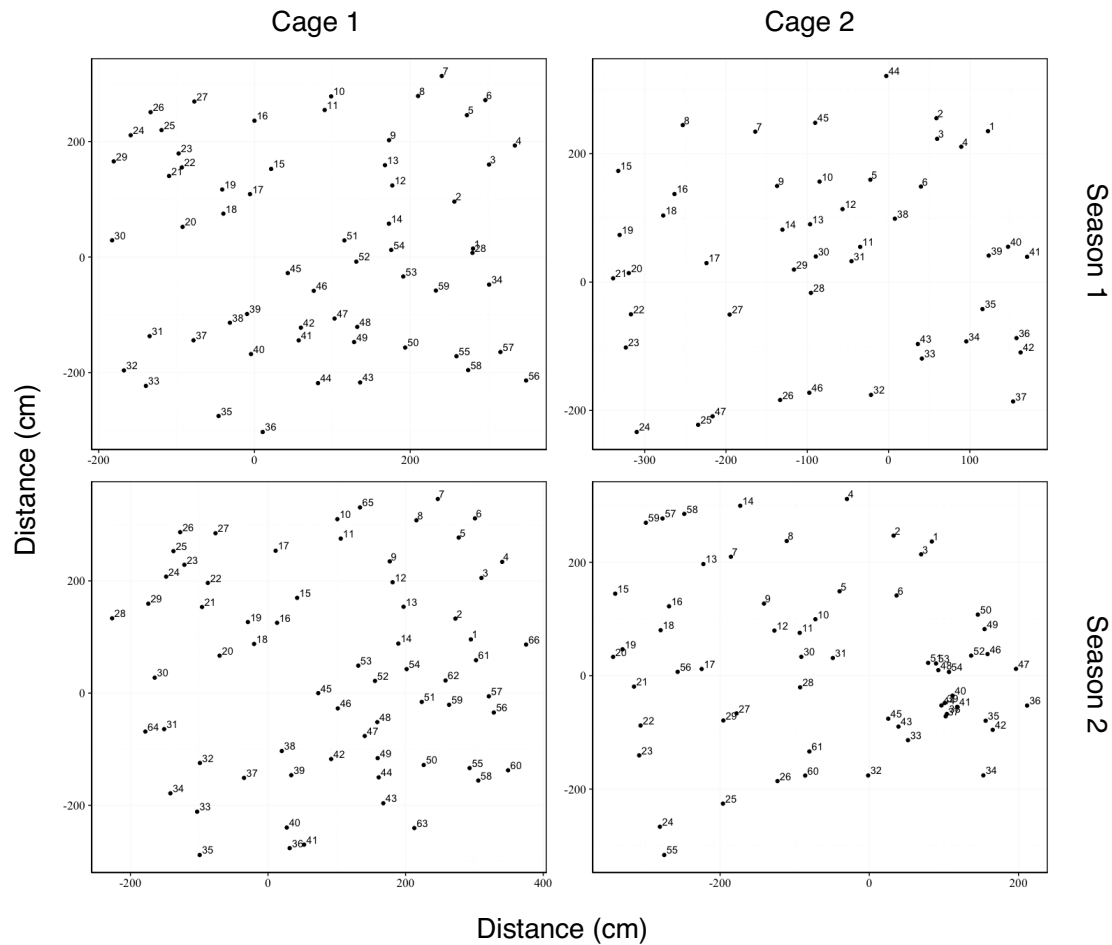


Figure S1: A spatial map of all bushes in both cages in both seasons exhibits the homogenous distribution of bushes inside the field enclosures. These bushes were mapped by measuring Euclidean distances between the centre of each bush and a reference point common to each enclosure. Polar coordinates measured using a survey compass and a metre tape were consequently converted to cartesian coordinates. Bushes were tagged and numbered in both cages in each season.

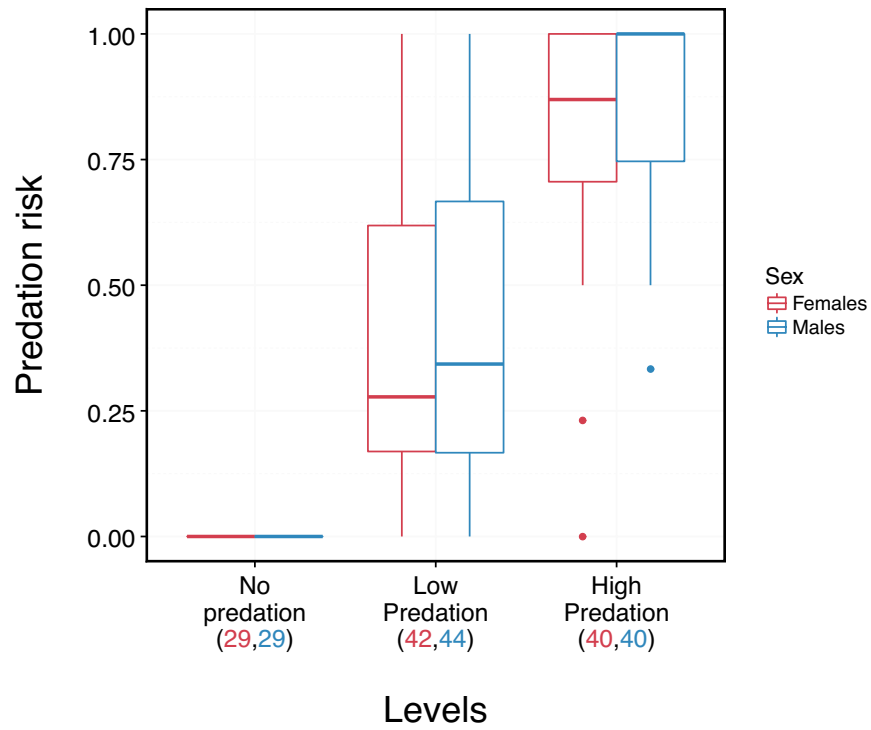


Figure S2. Predation risk encountered by crickets in different levels of predation risk. Predation risk is the probability of a cricket co-occurring with a spider on a bush across all nights it survived till the end of the experiment. Male and female crickets within each level experience similar predation risk. Numbers in parentheses are sample sizes (number of crickets).

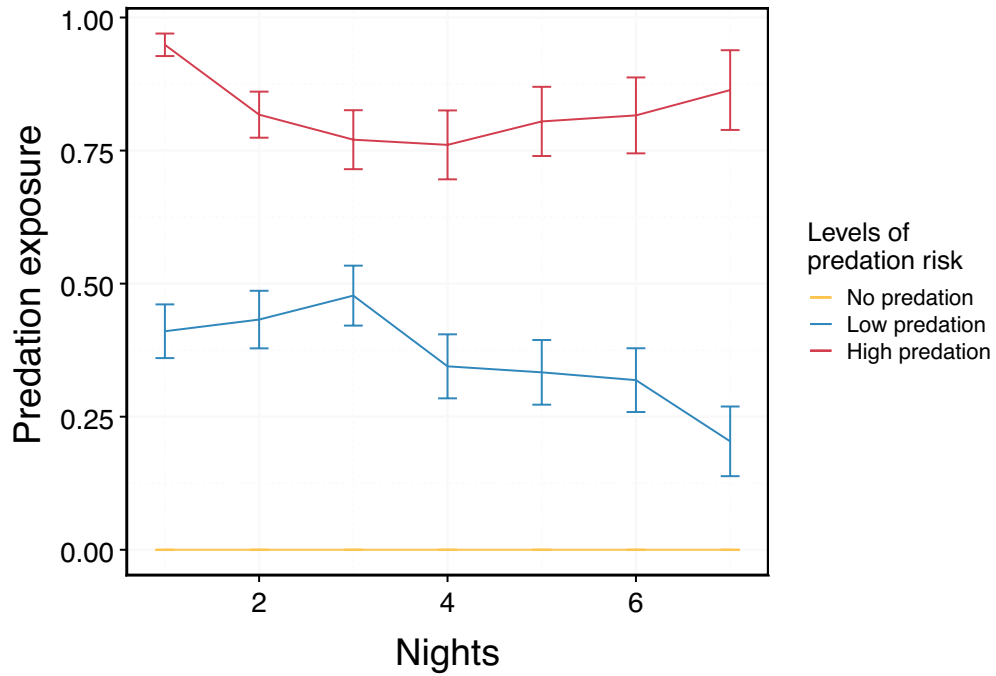


Figure S3. Predation risk encountered by crickets in different levels of predation risk across the extent of each experiment. Predation exposure is the probability of co-occurrence with a spider on a bush for all surviving crickets in the enclosure on each night. Error bars are standard errors.

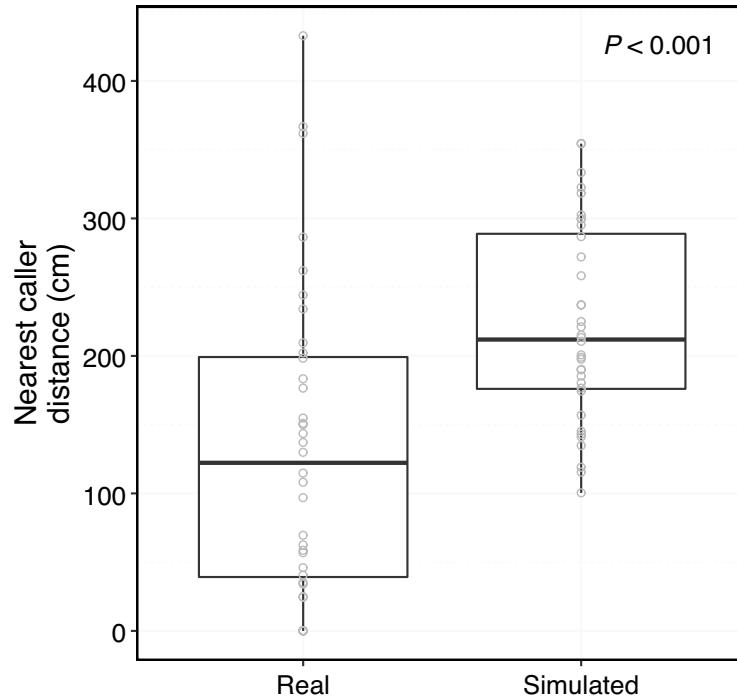


Figure S4. Movement as a satellite strategy when a spider is present on the bush from which the cricket initiated movement ($n = 36$). A comparison of distance to the closest caller when a male cricket moved in the enclosure when experiencing predation risk. 'Real' represents the empirical data of male movement and 'Simulated' represents the simulated data based on the null hypothesis of random movement to any bush. Points shown are actual distances to closest caller in the 'real' category, and medians of distributions of distances to closest caller when movement was simulated.

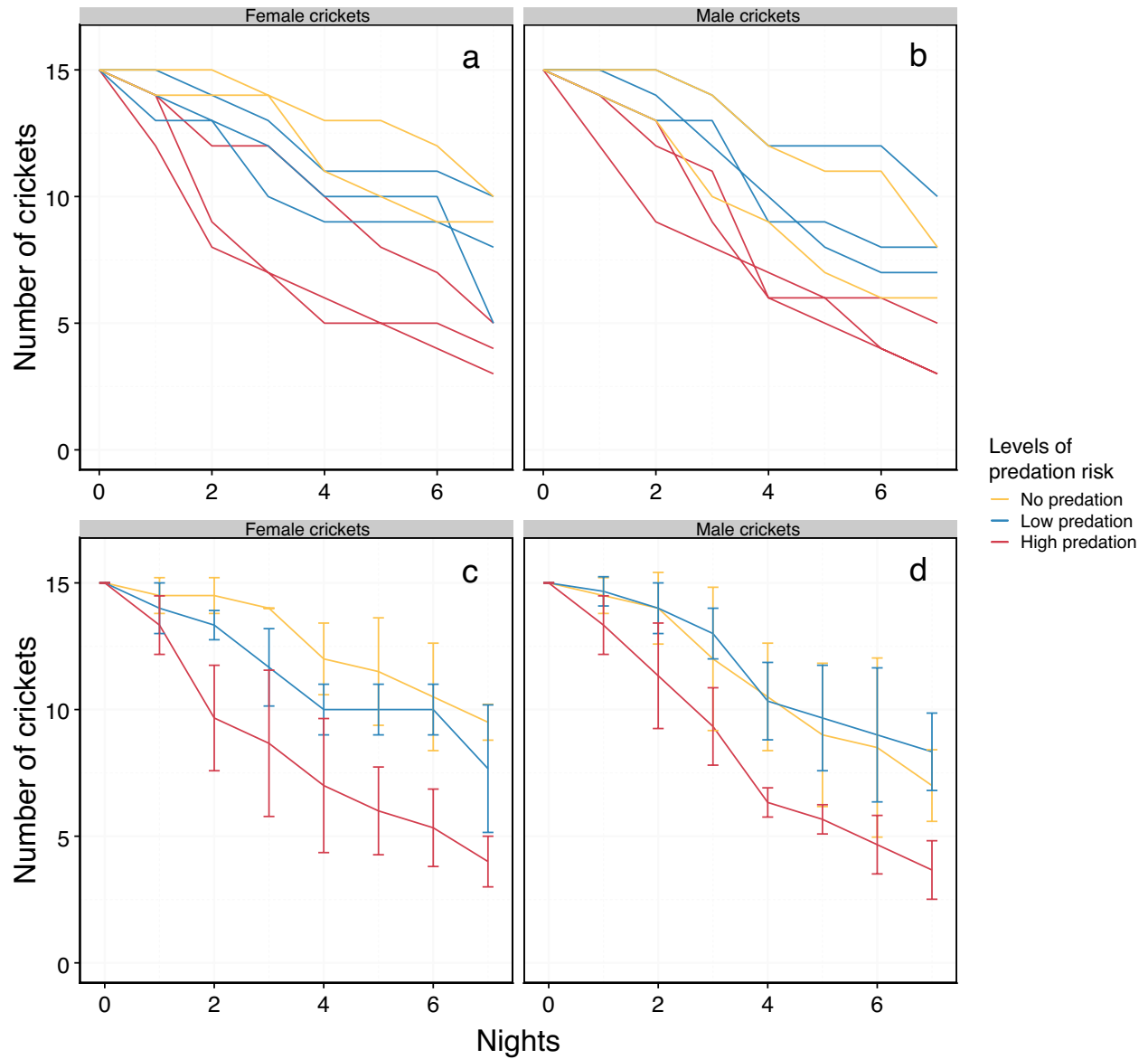


Figure S5. Number of crickets surviving on each night plotted for all experiments for female (a,c) and male (b,d) crickets. Survival of crickets plotted separately for each experiment (a,b) and for each level of predation risk (b,d) with error bars denoting standard deviation.

References

- Bates, D., Maechler, M., Bolker, B. & Walker, S. (2014) lme4: Linear mixed-effects models using Eigen and S4. *R package version*, **1**, 1–23.
- Brooks, M.E., Kristensen, K., van Benthem, K.J., Magnusson, A., Berg, C.W., Nielsen, A., Skaug, H.J., Machler, M. & Bolker, B.M. (2017) glmmTMB balances speed and flexibility among packages for zero-inflated generalized linear mixed modeling. *The R Journal*, **9**, 378–400.
- Zuur, A.F., Ieno, E.N., Walker, N., Saveliev, A.A. & Smith, G.M. (2009) *Mixed Effects Models and Extensions in Ecology with R*. Springer Science & Business Media, New York, NY.