Bush-crickets show lifelong flexibility in courtship signals to match predation threat

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Abstract

Courtship signals may attract predators. Thus, finding a mating partner and avoiding predation are contradicting tasks with direct fitness consequences. It is unclear, however, how prey species balance the costs and benefits of those vital tasks over their lifetime. Here, we quantified how a prey species with a conspicuous courtship song, the bush-cricket *Tettigonia viridissima* (Orthoptera: Tettigoniidae), adjusts its singing behaviour in response to increasing levels of bat predation threat and how those adjustments change in the course of its lifetime. We show that young males favour survival over mating by acoustically hiding from predators for a longer time, while old males prioritize mating over survival. Thus, males of different ages trade-off differently the risk of losing mating opportunities against the risk of falling prey to bats. This illustrates that even species with limited cognitive abilities are capable of carefully balancing the costs and the benefits of reproduction and survival by making different choices throughout their lifetime. Our results highlight the flexibility of vital behaviours and demonstrate how they are balanced over a lifetime to maximize fitness.

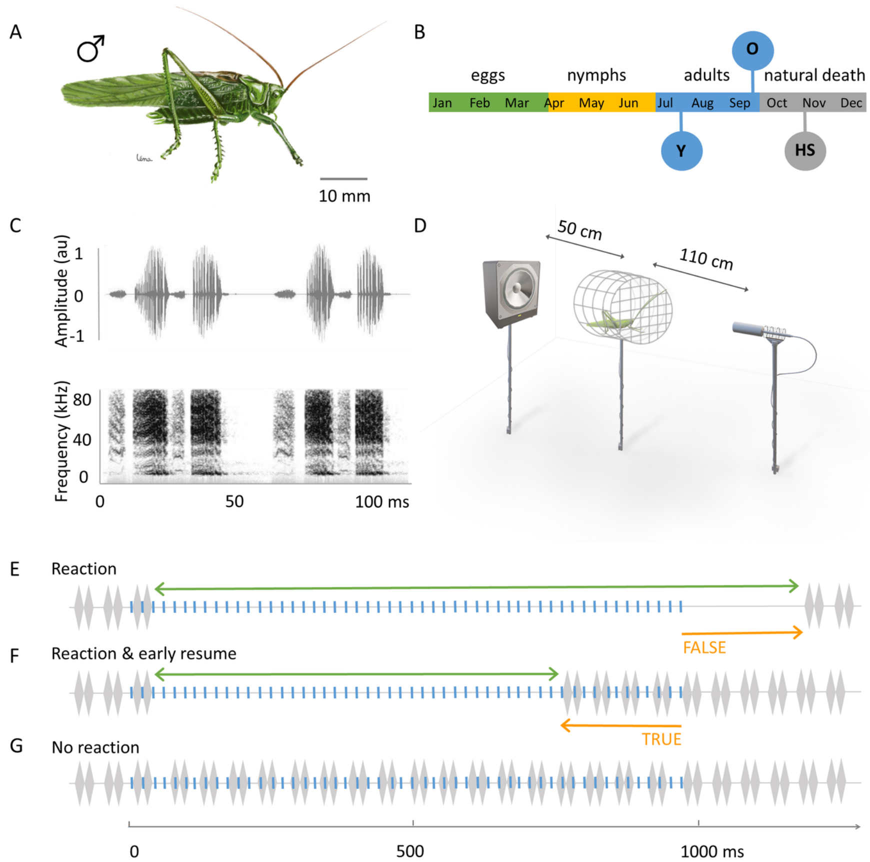

Figure 1: Overview of the experimental species, test design and data analysis A) Male great green bush-cricket, Tettigonia viridissima. B) Life cycle of male T. viridissima in NE-Bulgaria and the timing of the experiment. The coloured circles indicate the timing of the behavioural tests (Y: young, O: old bush-crickets) and of the neurophysiological recording of the hearing sensitivity (HS). Note that the individuals used for the neurophysiological recordings were much older than they get in nature. C) Oscillogram (top; au: arbitrary units) and spectrogram (bottom) of the mating song of T. viridissima. The song covers frequencies from 8 to 85 kHz with a peak frequency at 10 kHz. D) Schematic representation of the experimental setup. Six different acoustic treatments were presented from a loudspeaker to a caged male bush-cricket, whose mating song was recorded with a microphone. E-G) Schematic representation of the singing behaviour of T. viridissima (grey) in response to a 960 ms long sequence of bat-like calls (blue). After the stimulus onset, we observed one of three behaviours: Reaction (E): the bush-cricket stopped singing and resumed singing only after the end of the stimulus; Reaction & early resume (F): the bush-cricket stopped singing but resumed the song while the stimulus was still playing; and No reaction (G): the bush-cricket did not stop singing at all. We analysed for how long the busk-crickets stopped singing (pause duration, green arrows) and whether they resumed singing after (early resume=FALSE) or before (early resume=TRUE) the end of the stimulus (orange arrows).

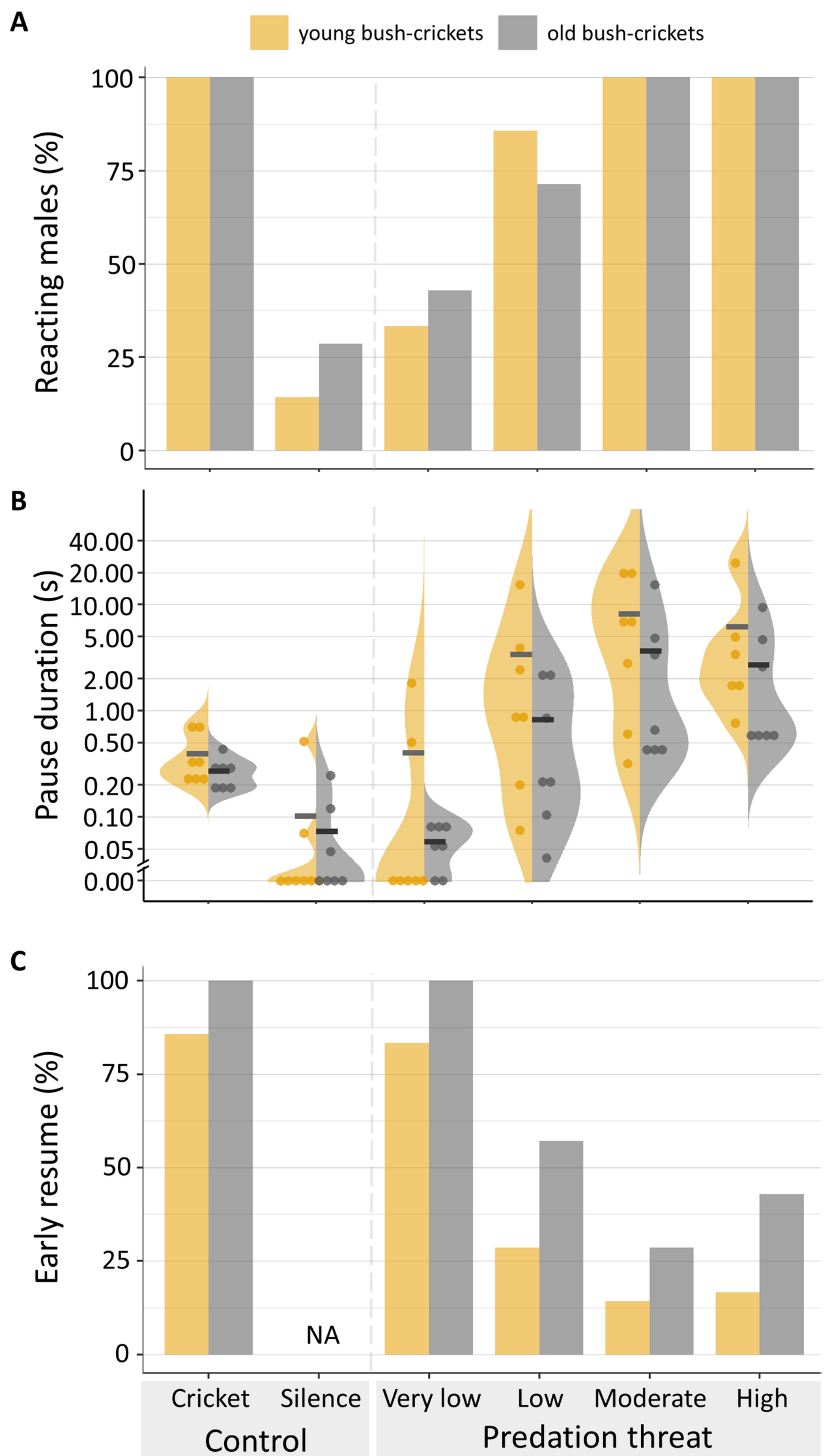

Figure 2: Singing male bush-crickets adjust their anti-predator defence to predation threat and age. Individual bush-crickets received six acoustic treatments of 960-ms duration each: two control sounds, one resembling the song of a sympatric innocuous cricket (88 dB SPL RMS re. 20 µPA) and the other one being silence, and four levels of predation threat (from 'very low' to 'high') consisting of sequences of bat-like calls with increasing sound pressure levels (57, 67, 77 and 87 dB SPL RMS re. 20 µPA). Data are shown separately for young (yellow, N=7) and old males (grey, N=7). A) The percentage of males that stopped singing their courtship song increased with increasing predation threat, but was independent of age. B) The pause duration of the song increased with increasing predation threat, and was shorter for old than young males. Split violin plots show raw data points, mean values (thick dark lines) and density curves (Kernel density estimation with 0.9 smoothing bandwidth). C) The percentage of singing males that resumed singing

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