Anecdote: When courtship blurs: a case of male-directed sexual signaling in house crickets (*Acheta domesticus*)

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Abstract:

Same-sex sexual behaviour has been reported across diverse animal taxa and is increasingly understood as a flexible outcome of sexual signaling rather than an evolutionary anomaly. In insects, such behaviours are often temporary, context dependent, and expressed alongside opposite-sex courtship. This pattern has led to increasing emphasis on condition-dependent mating filters, defined as how selectively individuals direct sexual signals toward potential mates. Here, I report a rare and, to my knowledge, first observation of male-directed sexual signaling in the house cricket (*Acheta domesticus*). In a video recorded during routine behavioural assays, an adult male produced sexual acoustic signals, courtship calls, toward another male. Simultaneously, this male directed aggressive signals toward other individuals within the same arena. This behaviour occurred under standardized laboratory conditions with a high-quality diet, ruling out nutritional stress as an explanation. Notably, the individuals involved originated from highly inbred laboratory lines, suggesting that extreme homozygosity may represent an overlooked source of variation influencing sexual signaling. This observation highlights the value of documenting rare behaviours and suggests new avenues for exploring the role of genetic context in mating filters and sexual communication.

Key words: same-sex sexual behaviour, sexual signaling, mating filters, inbreeding

Introduction

Same-sex sexual behaviour has been documented across diverse animal taxa, including mammals, birds, reptiles, fishes and insects (Adkins-Regan, 2002; Fruth et al., 2006; Bailey & Zuk, 2009; Levan, Fedina, & Lewis, 2009a; Grinham, 2026). These behaviours include courtship displays, mounting, copulation attempts and long-term pair bonds, which could occur in both wild and captive contexts (Bailey & Zuk, 2009). Early interpretations often framed same-sex sexual behavior as an evolutionary paradox, largely because such interactions do not directly result in reproduction (Young, Zaun, & VanderWerf, 2008; Bailey & Zuk, 2009; Levan, Fedina, & Lewis, 2009b). However, a growing body of literatures shifted this view, emphasizing that same-sex sexual behaviour can arise from flexible mating systems, lenient recognition thresholds, or context dependent decision rules rather than from maladaptive error alone (Bailey & Zuk, 2009; Richardson, Hoversten, & Zuk, 2024).

Two well-studies examples illustrate this broader perspective. In bottlenose dolphins (*Tursiops spp.)*, male-male sexual interactions appears to function in alliance formation and social bonding, with potential downstream benefits for reproductive success (Mann, 2006). In birds such as Laysan albatrosses (*Phoebastria immutabili*), female-female pair bonds can persist for multiple breeding seasons and may represent a conditional strategy in populations with skewed sex ratios (Young, Zaun, & VanderWerf, 2008). These cases shows that same-sex sexual behavior can be seen within social and ecological context that shape its expression and consequences, rather than existing as an isolated studies.

In insects, same sex sexual behavior has been reported in multiple orders including Diptera, Coleoptera, and Orthoptera (Scharf & Martin, 2013). In many cases these behaviors are temporary, context dependent, and occur alongside opposite-sex courtship suggesting broad acceptance thresholds for sexual signaling (Scharf & Martin, 2013). This pattern has motivated recent theoretical and empirical work framing same-sex sexual behavior as an outcome of flexible ‘mating filters’, where individuals vary in how selectively their direct sexual signals towards potential mates (Richardson & Zuk, 2023).

Crickets provide an excellent system for studying sexual signaling, as males produce distinct acoustic signals associated with mate attraction, courtship, and aggression (Alexander, 1961, 1962). In some cricket species, males occasionally direct courtship behavior toward other males, including the production of courtship song or mounting attempts (Boutin et al., 2016). Recent experimental work has demonstrated that such behaviors can be condition dependent. In Pacific field crickets (*Teleogryllus oceanicus*), males reared in low quality diets showed reduced expression of same-sex sexual behavior compared to males in good condition, while maintaining normal levels of courtship toward females (Richardson, Hoversten, & Zuk, 2024). These findings support the idea that mating filters can narrow when the energetic or opportunity costs of misdirected courtship increase.

Importantly, this experimental work links same-sex sexual behavior to nutritional condition rather than to developmental abnormality or sensory failure (Richardson, Hoversten, & Zuk, 2024). Under this framework, same-sex courtship emerges as an expected consequence of permissive signaling rules under certain conditions, rather than as a mistake requiring a special explanation (Richardson & Zuk, 2023; Richardson, Hoversten, & Zuk, 2024). However, most empirical studies in crickets have focused on diet quality or short-term condition as drivers of variation in same-sex sexual behavior, leaving other potential sources of behavioral variation largely unexplored.

A rare observation in the house cricket (*Acheta domesticus*)

Here, I report the rare and, to my knowledge, previously undocumented occurrence of male-directed sexual signaling in the house cricket (*Acheta domesticus*). The observation of this behavior comes from a video recording collected during routine behavioral assays conducted under controlled laboratory conditions.

In the video, one adult male clearly produces sexual signals, courtship calls, directed toward another male (Figure 1a). These signals include acoustic elements typically associated with mating contexts, rather than purely aggressive interactions. Notably, within the same observation period, the focal male also produces aggressive signals toward multiple individuals in the same arena (Figure 1b), suggesting that sexual and agonistic signaling are expressed toward different social partners within a shared space. The

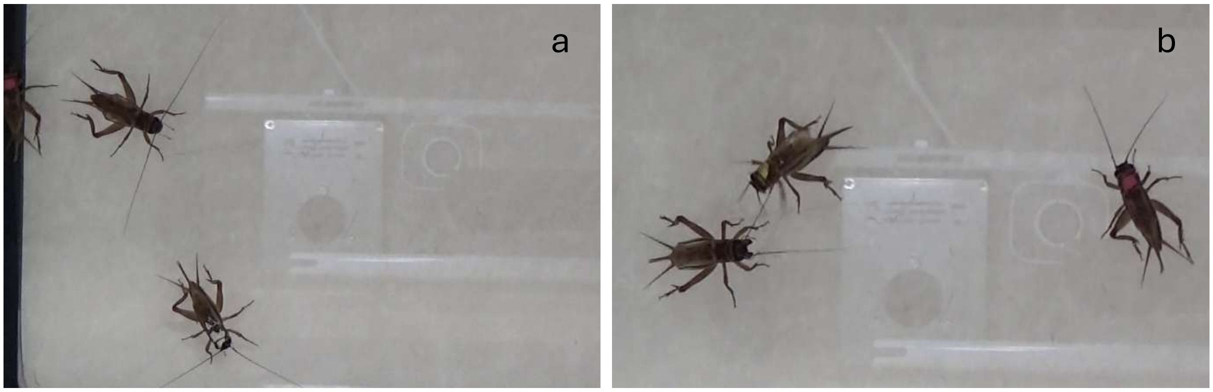

Figure 1: Context dependent signaling in *A. domesticus*. (a) Focal male (unmarked pronotum) directing mating calls toward a pink-marked male. (b) The same male displaying aggressive signals toward yellow-marked males while the pink-marked individual remains present.

signaling male also performed stereotypical behaviors and motor patterns that are part of the Gryllidae copulatory sequence (Supplementary File 1, (Sakai & Kumashiro, 2004)).

The video (Supplementary File 1) and still frames (Figure 1) illustrate the focal male's signaling behavior, the spatial arrangement of individuals, and the absence of females in the immediate signaling context.

This observation is striking for several reasons. First, same-sex sexual signaling has not been reported in *A. domesticus*, despite the species being one of the most intensively studied crickets in laboratory research. Male house crickets are well known for producing distinct signals during aggression, including mandible flaring and escalated acoustic displays, while sexual signaling is typically directed toward females and occurs in specific courtship contexts (Gray, 1997; Buena & Walker, 2008; Sekhar et al., 2025). Females do not exhibit these signaling behaviours, and male signals are generally interpreted as sex specific and context dependent (Alexander, 1962; Gray, 1997).

Second, the behavior described here cannot be attributed to poor nutritional condition. All individuals involved were reared on a standardized, high-quality diet under consistent environmental conditions. This distinguishes the present observation from previous work linking same-sex sexual behavior in crickets to dietary manipulation or reduced condition. This observation raises the question of whether unusual genetic or social contexts might contribute to the expression of such behavior. One relevant aspect of the individuals involved is their genetic background.

Inbreeding as a potential contributor

The individuals involved in this observation originated from laboratory lines of *A. domesticus* generated through repeated full-sibling matings following standard quantitative genetic protocols (Falconer & Mackay, 1983). These lines were derived from a stock population obtained in 2021 and maintained under controlled laboratory conditions with standardized, high-quality diet and husbandry. Full-sibling matings were conducted for 14 consecutive generations, resulting in an expected inbreeding coefficient exceeding 0.94 for the individuals observed. Thus, the behavior described here occurred in a context of extreme homozygosity, rather than nutritional stress or atypical rearing conditions.

Inbreeding is well known to influence a range of fitness-related traits, including mating behavior, aggression, and signal production (Pusey & Wolf, 1996; Drayton et al., 2007; Duffield et al., 2019; Townsend, Williams, & Nannas, 2024). While inbreeding is most often discussed in terms of reduced performance or viability, (i.e. inbreeding depression), it can also lead to altered behavioral expression by modifying neural or sensory pathways underlying social interactions (Bansal et al., 2021; Townsend, Williams, & Nannas, 2024).

In the present case, extreme inbreeding may have altered the integration of sensory cues or the balance between aggressive and sexual signaling pathways, resulting in the expression of sexual signals toward an atypical social target.

Importantly, this interpretation remains speculative. The nature of the observation excludes causal inference, and no claims are made here about adaptive function. The occurrence of same-sex sexual behavior is also, apparently, rare in *A. domesiticus*. The behavior was observed from only one male out of 448 individuals observed over a total of 28 hours of recordings for this population of *A. domesticus*. However, the combination of normal rearing conditions and extreme inbreeding distinguishes this case from existing studies and suggests a novel axis of variation worth further investigation.

Implications and future directions

Although based on a single observation, this anecdote raises several broader questions relevant to the study of sexual signaling and social behavior. First, it suggests that same-sex sexual signaling may occur in *A. domesticus* under rare or previously overlooked conditions. Second, it highlights inbreeding as a potential contributor to variation in mating filters, independent of nutritional condition. Third, it underscores the importance of reporting well-documented but unexpected behaviors, even when they fall outside the scope of formal hypothesis-driven experiments.

Future work could explicitly test whether inbreeding influences mating filter breadth, signal discrimination, or the coupling between aggression and courtship in crickets. Comparative studies across inbred and outbred lines, combined with manipulations of social context, could help determine whether the behavior reported here reflects altered sensory processing, relaxed acceptance thresholds, or context-dependent signaling strategies. More broadly, integrating genetic background into studies of same-sex sexual behavior may reveal additional sources of variation that have been underappreciated in largely outbred experimental systems.

By making this observation available to the scientific community, I hope to encourage further documentation, replication, or contrast by other researchers working with crickets or related taxa. In this sense, the anecdote serves not as a conclusion, but as an invitation for reflection, comparison, and future study, aligning with the goal of protecting rare but potentially informative behavioral observations from being lost to anonymity.

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Conflict of interest

The author declares no conflict of interest.

Supplementary files

Video files: https://doi.org/10.6084/m9.figshare.31366156

References

Adkins-Regan, E. (2002). Development of sexual partner preference in the zebra finch: a socially monogamous, pair-bonding animal– Arch. Sex. Behav. 31: 27–33.

Alexander, R.D. (1961). Aggressiveness, territoriality, and sexual behavior in field crickets (Orthoptera: Gryllidae)– Behaviour 130–223.

Alexander, R.D. (1962). Evolutionary change in cricket acoustical communication– Evolution (N Y). 16: 443–467.

Bailey, N.W. & Zuk, M. (2009). Same-sex sexual behavior and evolution– Trends Ecol. Evol. 24: 439–446.

Bansal, R., Nagel, M., Stopkova, R., Sofer, Y., Kimchi, T., Stopka, P., Spehr, M., & Ben-Shaul, Y. (2021). Do all mice smell the same? Chemosensory cues from inbred and wild mouse strains elicit stereotypic sensory representations in the accessory olfactory bulb– BMC Biol. 19: 133.

Boutin, S.R.T., Harrison, S.J., Fitzsimmons, L.P., McAuley, E.M., & Bertram, S.M. (2016). Same-sex sexual behaviour in crickets: understanding the paradox– Anim. Behav. 114: 101–110.

Buena, L.J. & Walker, S.E. (2008). Information asymmetry and aggressive behaviour in male house crickets, Acheta domesticus– Anim. Behav. 75: 199–204.

Drayton, J.M., Hunt, J., Brooks, R., & Jennions, M.D. (2007). Sounds different: inbreeding depression in sexually selected traits in the cricket Teleogryllus commodus– J. Evol. Biol. 20: 1138–1147.

Duffield, K.R., Hampton, K.J., Houslay, T.M., Hunt, J., Sadd, B.M., & Sakaluk, S.K. (2019). Inbreeding alters context-dependent reproductive effort and immunity in male crickets– J. Evol. Biol. 32: 731–741.

Falconer, D.S. & Mackay, T.F.C. (1983). Quantitative genetics. Longman London.

Fruth, B., Hohmann, G., Vasey, P., & Sommer, V. (2006). Social grease for females? Same-sex genital contacts in wild bonobos– Homosexual behaviour in animals: An evolutionary perspective 389.

Gray, D.A. (1997). Female house crickets, Acheta domesticus, prefer the chirps of large males– Anim. Behav. 54: 1553–1562.

Grinham, L.R. (2026). Same-sex sexual behaviour in nonhuman primates– Nature Reviews Biodiversity 1.

Levan, K.E., Fedina, T.Y., & Lewis, S.M. (2009a). Testing multiple hypotheses for the maintenance of male homosexual copulatory behaviour in flour beetles– J. Evol. Biol. 22: 60–70.

Levan, K.E., Fedina, T.Y., & Lewis, S.M. (2009b). Testing multiple hypotheses for the maintenance of male homosexual copulatory behaviour in flour beetles– J. Evol. Biol. 22: 60–70.

Mann, J. (2006). Establishing trust: socio-sexual behaviour and the development of– Homosexual behaviour in animals: An evolutionary perspective 107.

Pusey, A. & Wolf, M. (1996). Inbreeding avoidance in animals– Trends Ecol. Evol. 11: 201–206.

Richardson, J., Hoversten, I.P., & Zuk, M. (2024). Male crickets in poor condition engage in less same-sex sexual behavior– Proceedings of the National Academy of Sciences 121: e2408811121.

Richardson, J. & Zuk, M. (2023). Rethinking same-sex sexual behaviour: male field crickets have broad mating filters– Proceedings of the Royal Society B: Biological Sciences 290.

Sakai, M. & Kumashiro, M. (2004). Copulation in the cricket is performed by chain reaction– Zoolog. Sci. 21: 705–718.

Scharf, I. & Martin, O.Y. (2013). Same-sex sexual behavior in insects and arachnids: prevalence, causes, and consequences– Behav. Ecol. Sociobiol. 67: 1719–1730.

Sekhar, M.A., Rothamer, B.A., Gillam, E., & Dochtermann, N.A. (2025). A saga of agonistic interactions in house crickets (Acheta domesticus): A direct and indirect effects perspective– bioRxiv 2021–2025.

Townsend, A.K., Williams, K.E.G., & Nannas, N.J. (2024). Inbreeding and cognitive impairment in animals– Behavioral Ecology 36.

Young, L.C., Zaun, B.J., & VanderWerf, E.A. (2008). Successful same-sex pairing in Laysan albatross– Biol. Lett. 4: 323–325.