

Correspondence

A parasitic, parthenogenetic ant with only queens and without workers or males

Keiko Hamaguchi^{1,5,6,*},
Kyoichi Kinomura^{2,6}, Ren Kitazawa³,
Natsumi Kanzaki^{1,5},
and Jürgen Heinze^{4,5,*}

The typical ant colony consists of reproductive females ('queens'), non-reproductive females ('workers') and males that die shortly after mating¹. Rare deviations from this standard pattern² include the loss of workers in socially parasitic ants³ ('inquilines') and the absence of males in a few parthenogenetic taxa⁴. Here, we add a new variant: *Temnothorax kinomurai*⁵ is the first ant species known to lack both workers and males and to consist exclusively of queens.

T. kinomurai is a very rare inquiline ant known from only nine locations in Japan (K.H. and K.K., unpublished observations⁶). Young *T. kinomurai* queens usurp the small nests of a related species, *Temnothorax makora*, where they eliminate the host queen and some workers by stinging (Figure 1A). They then rear their own offspring with the help of the surviving host workers (Supplemental information). Thirty-one mixed colonies of *T. kinomurai* and *T. makora* collected between 1978 and 2020 in Honshu and Shikoku, Japan, contained a few dozen host workers and one to three gynomorphic, i.e., initially winged, or wingless, intermorphic queens (Figures 1B and S1A), suggesting queen polymorphism². None of these colonies had workers or males that could be assigned to *T. kinomurai*.

Anecdotal evidence from colonies reared in captivity over the last 40 years supported the field observations that *T. kinomurai* queens produce only young queens, but no workers or males (K.K., unpublished). To confirm these findings quantitatively, we collected six additional colonies of *T. kinomurai* from Yamada, Seki, Gifu,

and Yamashirocho-Kabata, Kizugawa, Kyoto in 2022 to 2024 and reared them in artificial nest boxes in the laboratory. From the collected brood, we obtained 24 gynomorphic and 19 intermorphic offspring queens. Queens produced both types of daughter queens but no workers or males. A close examination of the genitals of 42 pupae ruled out the presence of morphologically queen-like males. Of 43 lab-reared, definitely unmated daughter queens, which were given the opportunity to take over a *T. makora* colony or groups of *T. makora* workers and brood under controlled conditions, only three gynomorphic and four intermorphic queens survived to produce offspring, in line with the typical high failure rate of parasitic colony founding³. The remaining queens were either killed by workers or died outside the host nest. The unfertilized eggs of the seven successful queens developed into 41 gynomorphic and 16 intermorphic queens. Again, no males or workers were produced (Figure S2). Dissection of the ovaries revealed that they consist of six ovarioles in gynomorphic queens (n = 4), whereas four to six ovarioles could be detected in intermorphic queens (n = 3), compared to eight

ovarioles in *T. makora* host queens (n = 4) and two ovarioles in *T. makora* workers (n = 8). Furthermore, the spermathecae (the organs used by the queens to store sperm) were considerably smaller in diameter in *T. kinomurai* than in *T. makora* host queens and were likely rudimentary (Figure S1B). We could never find any sperm in the spermathecae of *T. kinomurai*.

Our data therefore suggest that the life history of *T. kinomurai* is characterized by the unique combination of workerless parasitism and thelytokous parthenogenesis, i.e., the ability to produce female offspring from unfertilized eggs. *T. kinomurai* shares workerlessness with several other social parasites in ants, including a few species of the genus *Temnothorax*³. There is no evidence of thelytoky in other parasitic or free-living species of *Temnothorax* and related genera. Instead, all available data suggest mating and sexual reproduction (Supplemental information). However, thelytokous parthenogenesis has been reported in an increasing number of ant parasite species⁴, including the social parasite *Mycocepurus smithii*⁷. This latter



Figure 1. *Temnothorax kinomurai*, a workerless, parthenogenetic social parasite.

(A) Young, gynomorphic, i.e., originally winged, queen of *Temnothorax kinomurai* (left) attempting to sting a *T. makora* worker (right). (B) Nest of *T. kinomurai* containing young, winged gynomorphic and wingless intermorphic queens of *T. kinomurai* (light brown) and dark brown *T. makora* host workers.



species differs from *T. kinomurai* in that it produces workers, and males and sexual reproduction have been observed in several populations⁷.

The situation found in *T. kinomurai* is most similar to the occurrence of a ‘cheater’ lineage in the ant *Pristomyrmex punctatus*⁸ and a caste differentiation mutant in the ant *Ooceraea biro*⁹, where certain genotypes produce exclusively female sexual offspring through parthenogenesis. This has been interpreted as a possible mechanism by which reproductively isolated parasitic lineages may evolve from their free-living hosts^{8,9}. Although *T. kinomurai* appears to be a good candidate for such an evolutionary pathway, our preliminary phylogeny does not support the view that it evolved directly from its host (Figure S1C,D). Instead, *T. kinomurai* appears to be more closely related to the even rarer and less studied slave-making species *T. bikara*⁵, which parasitizes *T. spinosior* — a sibling species of *T. makora*. If corroborated by a more detailed analysis of the phylogeny of Japanese *Temnothorax*, this could imply that *T. kinomurai* evolved from slave-making ancestors by losing workers, as has been demonstrated in two other genetic lineages of *Temnothorax*¹⁰.

Though the ecological conditions that favor the loss of workers in social parasites are not yet fully understood, workerlessness is often associated with the switch from outbreeding to sib-mating, which consequently leads to highly female-biased sex ratios³. Saving the investment in males through parthenogenesis, as in *T. kinomurai*, may be an evolutionarily advantageous strategy, particularly in species where queens are intolerant of the host queen and rely on a small, diminishing number of host workers for brood rearing.

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DECLARATION OF INTERESTS

The authors declare no competing interests.

SUPPLEMENTAL INFORMATION

Supplemental information including two figures, as well as information on morphology and life history of *T. kinomurai*, experimental procedures and author contributions can be found with this article online at <https://doi.org/10.1016/j.cub.2025.11.080>.

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¹Kansai Research Center, Forestry and Forest Products Research Institute, 68 Nagaikyutaro, Momoyama, Fushimi, Kyoto city, Kyoto 612-0855, Japan. ²Yatsuume-cho, Gifu city, Gifu 500-8817 Japan. ³Shiga, Suwa city, Nagano 392-0012 Japan. ⁴Zoology/Evolutionary Biology, University of Regensburg, 93040 Regensburg, Germany. ⁵ORCID: <https://orcid.org/0000-0002-8169-7182> (K.H.); <https://orcid.org/0000-0001-8752-1674> (N.K.); <https://orcid.org/0000-0002-9403-5946> (J.H.). ⁶These authors contributed equally. *E-mail: hamaguchi_keiko350@ffpri.go.jp (K.H.); juergen.heinze@ur.de (J.H.)

Correspondence

An ancient dog breed regulates pitch when howling with music

Aniruddh D. Patel^{1,2,*}, Joanna Strogatz¹, Stacy Jo³, Sophie Barton³, Oliver Hollo³, Eliza Kallfelz³, Isain Zapata⁴, and Erin Hecht³

Singing occurs in every human society, most commonly as group singing where individuals coordinate their vocal pitches¹. Coordinating pitch with other *simultaneous* voices is not necessary for ordinary speech, which involves turn taking, yet this ability can develop without formal training and is a widespread component of human musicality². Did our ability to coordinate pitch in a group emerge as a byproduct of complex vocal learning or earlier because of its adaptive value? The latter possibility aligns with current theories of music origins, which posit that pitch-coordinated group vocalizations served to signal group strength and size or strengthen social bonds^{3,4}, implying the ability might exist in mammals without complex vocal learning. Wolves, for example, lack complex vocal learning but are suggested to ‘detune’ their howls during territorial pack displays to exaggerate group size⁵. Simultaneous pitch regulation could also serve prosocial functions of howling like pack reunion⁵, for example *via* convergence of vocal pitches. Thus we hypothesized that ancient breed dogs, which share more genetic similarity to wolves than do modern breeds⁶, would change vocal pitch when howling with frequency-shifted sounds. Utilizing the tendency of some dogs to howl along with music, we found that Samoyeds significantly changed mean vocal pitch when howling with music that had been shifted up *versus* down in frequency. This shows that simultaneous pitch regulation can evolve independently of complex vocal learning in group-vocalizing mammals and might predate the evolution of complex vocal learning in our ancestors.

We invited dog owners to participate in a home-based citizen science study of howling. Owners of ancient

