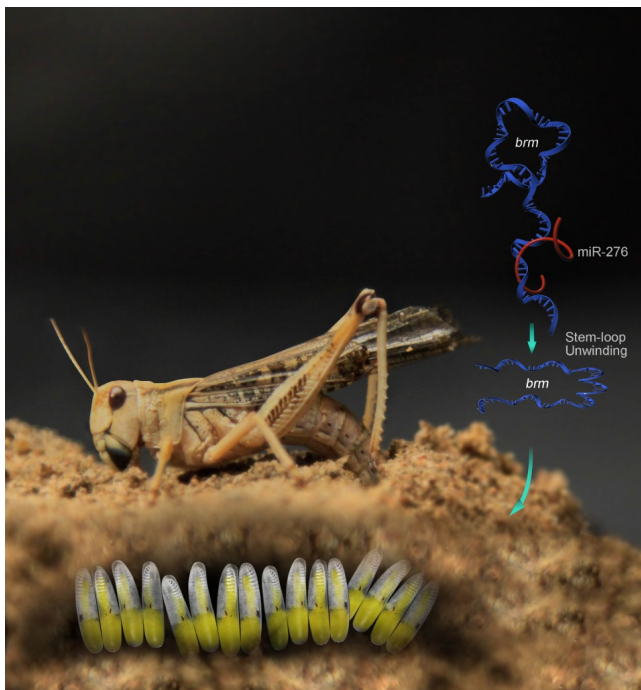


## Can the developmental synchrony be affected by the mothers?

Biological synchrony is a ubiquitous yet highly diverse phenomenon, with examples as wide-ranging as applause among humans, migration of fish and birds, aggregation of insects, and mass flowering of bamboos. Developmental synchrony, resulting from reduced fluctuation in individual development rates, is critical for swarming, migration, and social relationships of colonial animals. For example, synchronized estrous cycles in certain mammals are beneficial to secure male investment and increase birth rates. The emergence of beetles at the same time is essential for successfully attacking trees and then laying eggs. Reproductive synchrony in colonial swallows is beneficial for maximizing reproductive success. Birth synchrony is critical to juvenile synchronous emergence and group migration in turtles and to the provision of allomaternal care in some social group of mammals; for crustaceans and snowshoe hares, birth synchrony reduces the risk of being preyed.



This figure shows a female migratory locust (*Locusta migratoria*), eggs produced by the migratory locust, and the mechanism underlying synchronous egg-hatching. Synchronous development of eggs serves an important basis for the synchrony of hopper development, swarming, migration, and sexual maturation. The maternal miR-276 promotes developmental synchrony of the embryos by recognizing and unwinding of the secondary structure of brm (a transcription coactivator).

A growing number of studies focused on the underlying mechanisms of synchrony. The synchronized menstrual cycle in human beings may be regulated by chemical signals such as sexual pheromones; the egg-hatching synchrony in birds may be affected by egg constitutions, egg positions and other physiological factors; the mass flowering of bamboo may be controlled by physiological clocks; the mothers' vibration regulates the hatching synchrony of progeny in the crab. But what is the molecular regulators of synchronous development? Do the mothers' experiences influence the developmental synchrony of progeny?

The migratory locust is an ideal model for studying developmental synchrony: it transits between high-density gregarious and low-density solitary phases, with the former displaying more synchronous sexual maturation. As typically group living insects, gregarious locusts usually swarm and migrate together. Developmental synchrony is very important for the synchronous behavior such as mass migration in locusts. Egg-hatching synchrony is a crucial starting point for the locust development synchrony. Apart from this, egg traits such as egg size in locusts can be affected by the parents' population density. Do the eggs from the gregarious locusts develop more synchronously than those from the solitary locusts? Can the egg developmental traits be influenced by the parents? By investigating the egg hatching time, we found that the hatching time of eggs from gregarious locusts was more uniform compared with solitary locusts. More interestingly, a small RNA miR-276 (miR-276), which was significantly upregulated in both ovaries and eggs of gregarious locusts mediating progeny egg hatching synchrony. To be specific, inhibiting miR-276 in gregarious females and overexpressing it in solitary females, respectively, caused more heterochronic and synchronous hatching of progeny eggs.

MiRNAs are a kind of small noncoding RNA with the length about 22 nt, and they play important roles in stabilizing development processes against environmental perturbations. In addition, maternal miRNAs have an impact on germ cells and early embryo development in many organisms. Here we found maternal miR-276 mediated progeny egg hatching synchrony by upregulating its target gene *brahma* (*brm*), a transcriptional cofactor in early embryonic development. Generally speaking, miRNAs regulates target genes by triggering mRNA degradation or repressing translational. Curiously, miR-276 upregulated *brm* in the locust. Moreover, this upregulation effect was dependent on the secondary structure of *brm* RNA, namely, a stem-loop structure. By recognizing and impairing the stem-loop, miR-276 promoted the nuclear exporting of *brm* RNA and may eliminate the inhibitory effect of mRNA secondary structure on the translation elongation.

In conclusion, our study showed that the time distributions of progeny egg hatching varied in response to the population density encountered by parent locusts. We demonstrates a non-canonical mechanism of miRNA-mediated gene regulation and provide insight into regulation of developmental homeostasis and population sustaining which are closely related to biological synchrony.

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## **Publication**

[MicroRNA-276 promotes egg-hatching synchrony by up-regulating brm in locusts.](#)

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