

Female promiscuity can rescue populations from harmful effects of inbreeding

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Females in inbred populations become more promiscuous in order to screen out sperm from genetically incompatible males, according to new study by the University of East Anglia.

Published tomorrow in the journal *Science*, the findings help answer the puzzling evolutionary question of why females in most species mate with multiple males – even though a single male can provide full fertility and promiscuity can carry fatal risks for the female.

Using the red flour beetle as a model species, the researchers investigated the reproductive benefits of female promiscuity – or 'polyandry'. Polyandry, where a female's eggs are fertilized by multiple fathers, is the norm in most species, from chimpanzees to chickens, salmon to sea urchins. While biologists have recorded significant costs to females of this mating pattern, even death, these new findings show there can also be genetic benefits.

The UEA team found that the reproductive success of females in populations that were not inbred was identical, whether mating with one or five males. In inbred populations, females mating with just one male showed a 50 per cent reduction in the number of surviving offspring they could produce. However, inbred females who mated with five males managed to rescue their reproductive success back up to the levels of the non-inbred populations. The researchers checked to see if this could be explained by male infertility, but inbred males are just as fertile as non-inbred males. The effect was therefore due to genetic incompatibility

between males and females, which is prevalent when a population becomes inbred. Importantly, the results show that females possess mechanisms that allow them to filter in the genetically most compatible [sperm](#) to produce more viable offspring.

Having made this discovery, the researchers then went on to create deliberate genetic bottlenecks in populations of flour beetles and demonstrated for the first time that after as few as 15 generations, females began to change their mating patterns and behave far more promiscuously. Females from the previously bottlenecked populations mated with new males faster, more frequently, and for longer.

"By generating inbred populations, we were able to create real risks of high genetic incompatibility between reproducing males and females, and expose the mechanisms that females possess to promote fertilization by the most compatible males and their sperm," said lead author Prof Matthew Gage of UEA's School of Biological Sciences.

"These exciting results show how this common but paradoxical mating pattern can evolve if females use it to avoid reproducing with genetically incompatible males. Exactly how females filter the most compatible sperm is not yet understood. They might simply mate more frequently, and allow the 'best sperm to win', which would work if winning sperm are from males who have themselves avoided inbreeding depression. Or they might choose to mate most with the less related males, perhaps using olfactory cues, thereby concentrating their sperm stores from those males. We think that the process occurs most likely at the gamete level, because females mate with most of the males they are exposed to and only store for fertilization a tiny proportion of the sperm they are actually inseminated with. We know that sperm:egg recognition systems exist in other systems to avoid fertilization by unrelated species, and here it could run parallel where the system avoids fertilization by males that are too closely related."

The results could be of interest to those involved in breeding programmes, where providing [females](#) or their eggs with a choice might allow more compatible genes to be inherited.

"There's a telling example here from salmon restocking programs: should you maintain genetic diversity in the population by forcing each female to be fertilized by one different male, as is currently favoured, or should you let the natural mating pattern apply and give the eggs a choice of a mix of sperm? We're now testing this applied question directly with a project in Norway," added Prof Gage.

More information: Inbreeding promotes female promiscuity, by L Michalczyk et al., *Science* (2011).

Provided by University of East Anglia

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