Men are from Mars, Hermaphrodites are from Venus

Elie Dolgin describes the wriggly world of worm sex

Incest is taboo in human societies. If you marry your sibling, you could be sent to jail. In the worm's world, however, incest is commonplace. In fact, one species of worm engages in the most severe form of incest possible - having sex with itself. For these worms, single life is the norm and reproducing with another individual is a rare perversion.

For my PhD thesis in the Institute of Evolutionary Biology, I studied the nematode roundworm, *Caenorhabditis elegans*, a species that takes the do-it-yourself approach to the extreme. Most other closely related species are male-female, but this small bacteria-munching worm has evolved a unique mating system known as androdioecy, where females are absent, males are rare, and hermaphrodites capable of fertilising themselves are the norm. Because hermaphrodites can self-replicate, males aren't needed to propagate the species and most hermaphrodites remain footloose and fancy-free.

This begs the question, "who needs males anyway"? Answering this question has big implications well beyond this small worm. Determining the frequency and benefits of mating with other individuals rather than with oneself is crucial for understanding the evolutionary significance of males. This knowledge could also shed light on why many species, including humans, have equal numbers of males and females. Furthermore, understanding the contribution of males could help determine how genetic diversity, the fuel of evolutionary change, is maintained.

> "Mating with males may be genetically costly for *C.elegans* hermaphrodites"

One long-held idea is that males are beneficial because they allow for the shuffling of the worm's genes. My research, however, showed that mating with males is potentially genetically costly. In comparing the fertility of inbred hermaphrodites with those that mated with random males, I found that the pure-strain, inbred individuals had more offspring. This suggests that it's best for *C. elegans* to maintain its genetic integrity, and that most hermaphrodites are better off having sex with themselves than with any Tom, Dick, or Harry.

The same is not true for other less incestuous worms though. I set up similar crosses with the related species *Caenorhabditis remanei*, a worm with males and females rather than hermaphrodites and one that does not normally inbreed in the wild. I found that reproduction is a much less family-friendly affair: brother-sister matings in this species produced drastically fewer viable offspring.

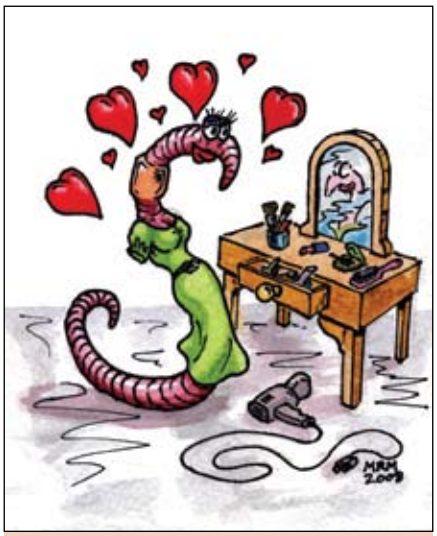
The key to this phenomenon might lie in the worms' evolutionary histories. *C. elegans*' ancestor had separate males and females, just like *C. remanei* does today. At some point in *C. elegans*' past, however, females found a way to make their own sperm, thereby transforming them into hermaphrodites. When this happened, the worms would have had to deal with the usual problems associated with inbreeding, such as lower fertility levels, just as I found with *C. remanei*. Through natural selection, those worms best suited for the solitary lifestyle would have left more descendants, and over time these worms would have become even more accustomed to life on their own. These are the descendents that we find today.

Although my research has looked for adaptive reasons to explain the existence of males, I might be searching in vain. Males may continue to worm their way into the breeding system by forming a type of gentleman's club, with the parlour game being the struggle for their own survival. In the battle of the sexes, even though males are harmful to hermaphrodites, they can persist by looking after their own kind. If the early worm catches the bird, albeit infrequently, the males will mate often enough to prevent their own extinction.

Still, the future may not be so bright for *C. elegans* males. Recent evidence indicates that hermaphrodites have developed resistance to an immobilizing factor that males secrete during mating. What's more, hermaphrodites have stopped producing a male-attracting pheromone. So while a few good men currently remain, if the hermaphrodites can successfully avoid their courters' advances, the males could be doomed. If this happens, the hermaphrodites may wriggle their way out of the malicious male matings once and for all.

Let this then be a lesson to everyone who takes gender equality for granted; even the worm will turn!

Elie Dolgin is a recent PhD graduate from the Institute of Evolutionary Biology



Mark R. Miller

"Who needs males anyway?"; hermaphrodite C.elegans worms simply need themselves.