

# Dinner for Two? Make that One! Sexual Cannibalism in Animals

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The female praying mantis cannibalizing her male counterpart: it's an example of weird animal behavior that has left textbooks and entered popular culture. The behavior, which is called sexual cannibalism, begs a lot of questions. Why do female praying mantises cannibalize their mates? Doesn't this behavior disincentivize mating? Why don't male praying mantises do something about it?

For starters, sexual cannibalism is not a behavior that is unique to just praying mantises. Sexual cannibalism, or the consumption of one's mate prior to or after sexual intercourse, is common among insect, arachnid (spiders and scorpions), and amphipod (an order of animals that include sand hoppers and freshwater shrimp) species [1]. It is often, but not always, instigated by the female party. For instance, a study by Drs. Sentenská and Pekár from Masaryk University found that some male spiders will cannibalize female counterparts [2]. Examining a species of ground spider called *Micaria sociabilis* in a laboratory setting, Drs. Sentenská and Pekár found that male spiders would often eat older, female spiders. Additionally, sexual dimorphism (the physical differences between biological sexes) played an important role. While many arachnid species have larger females that will cannibalize their smaller, male mates, spiders in *M. sociabilis* are similarly sized, with males of large sizes more likely to participate in sexual cannibalism. It's an interesting twist to a longstanding trend of female dominance!



*The classic example of sexual cannibalism: a female praying mantis eating her male mate (taken by Carin Bondar) [3]*

But why does sexual cannibalism even exist? Biologists have multiple hypotheses for this exact question! The first is the adaptive foraging hypothesis [4]. Let's break this down really quick. An adaptive trait is one that increases an organism's fitness relative to an organism that doesn't have the trait, while "foraging" refers to the consumption of food. In the case of sexual cannibalism, the desire for nutrients can overpower the desire for mating, leading females to eat males instead of mate with them. For example, starving female redback spiders are more likely to cannibalize their potential mates. Additionally, sexual cannibalism is also associated with better reproductive outcomes. A 2012 study on a species of funnel-web spider (*Agelenopsis pennsylvanica*) found that sexual cannibalism was associated with larger egg case mass and more offspring [5]. In summary, the adaptive foraging hypothesis simply claims that sexual cannibalism is a behavioral trait that improves an organism's ability to survive and have more offspring that are larger and more likely to survive.

Some biologists find the sexual selection hypothesis a bit more convincing. Sexual selection is a form of natural selection based on individuals of one sex choosing (selecting) for specific characteristics in another sex [6]. The classic example is that of the peacock. Female peacocks have selected more colorful males for so many generations that male peacocks now have very large, colorful tail feathers [6]. In a similar fashion, female garden spiders (*Araneus diadematus*) may use cannibalism as a form of sexual selection [7]. Female garden spiders will attack all males, and the weaker, smaller males that do not survive will end up consumed. This means that only strong and large male garden spiders end up mating with females, producing offspring that are more likely to be larger and stronger, leading to a cycle that continues on and on.



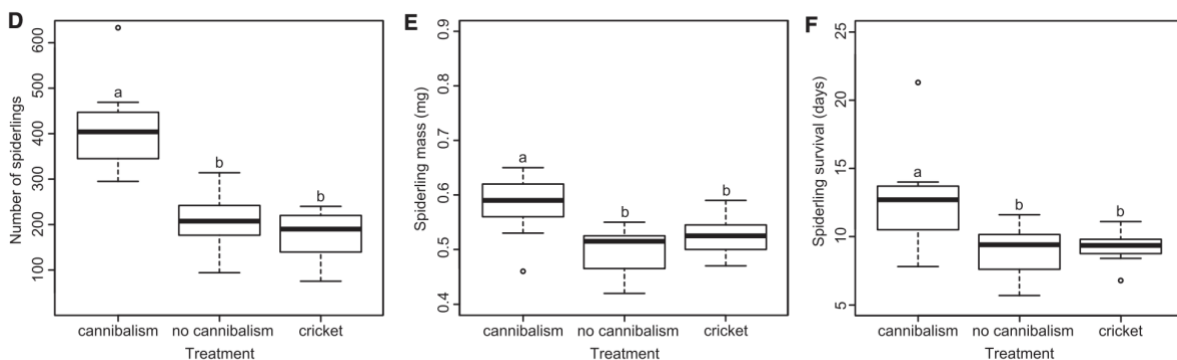
*A male garden spider (right, smaller) trying to make the difficult choice to mate with the larger female garden spider (left) (filmed by George Pilkington) [8]*

Finally, the third hypothesis that stands out is based on disordered behavior. One prediction based on disordered behavior is that sexual cannibalism is the result of overly aggressive females [9]. For example, a study on fishing spiders by Drs. Arnqvist and Henriksson

at the University of Umeå found that sexual cannibalism is a form of aggression spilling over to the context of mating [10]. Alternatively, sexual cannibalism can be the result of mistaken identity. Returning to the study by Drs. Sentenská and Pekár on ground spiders, some male ground spiders, because of old age or injury, may be unable to produce the pheromonal or vibratory signal required to distinguish themselves to their female counterparts [2]. As a result, female ground spiders mistake the male ground spiders as prey, then attacking them.

It's worthwhile to note that these hypotheses are hardly contradictory. In fact, they may be acting in concert. Or perhaps sexual cannibalism evolved independently in different species and have different underlying mechanisms. Whatever the reason, males in multiple species have evolved behaviors to counter sexual cannibalism. We call these behaviors in response to the negative pressure of natural or sexual selection "adaptive behaviors". One prominent example of an adaptive behavior is that of the orb-weaving spider species like *Nephila fenestrata* [11]. Male orb-weaving spiders can avoid sexual cannibalism by mating opportunistically, such as mating with the female when she is distracted with feeding or making webs. This successful approach allows males to survive the experience of mating.

However, the three hypotheses do not account for the fact that some males seem to just sacrifice themselves after mating, hardly resisting while their mates cannibalize them. This is distinct from the sexual cannibalism that may occur prior to mating that can be explained by many hypotheses. How could this sacrifice be adaptive? A study on dark fishing spiders (*Dolomedes tenebrosus*) by Dr. Schwartz and colleagues at the University of Nebraska-Lincoln aimed to answer this exact question [12]. They found that the self-sacrifice of male dark fishing spiders after mating led to increased mass, number, and survivability of offspring. Even when compared to the control group of feeding crickets to the female spiders, sexual cannibalism of the males produced significantly better offspring outcomes. As a result, this sacrifice is not particularly selfless; instead, it improves the male's chances of having offspring, and thus passing along his genes.



A figure from Schwartz et al, describing sexual cannibalism as producing more offspring that are larger and more likely to survive than those of the control groups of no cannibalism or feeding crickets to the female spiders. [12]

From a war between the sexes to overly aggressive females, the reasons for sexual cannibalism are complex. Complicating things is the evolution of adaptive behaviors. However, there's also some evidence that some males are willing parties to sexual cannibalism. While human couples are not going around cannibalizing each other (thankfully), the intricate and gruesome nature of sexual cannibalism makes it a fascinating phenomenon that could benefit from more research.

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