

Progeny Above All



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Dr. Agata Plesnar-Bielak studies sexual selection and sexual conflict and their impact on various evolutionary processes and the populations. Her interests also include species that have developed two distinct types of males, with different appearance and reproductive strategies.

Gender inequality is not a unique trait of our species. It turns out to be quite a widespread phenomenon in the animal kingdom, and can be attributed to differing amounts of resources invested in reproduction. What kinds of strategies are adopted by each side of this conflict? And whose interests will ultimately turn out to be less important?

The origins of the “war of the sexes” date all the way back to the very beginning of sexual differentiation itself, when the first distinct gametes evolved and specialized into sperm and egg cells. It takes a lot more resources for a female organism to produce an egg cell, large and rich in nutrients, than for a male organism to generate a small sperm cell. Hence, each gender may naturally adopt a different reproductive strategy.

Males, with large quantities of “inexpensive” sperm cells, try to inseminate as many females as possible because the number of progeny they leave behind depends on the number of successful copulations. For females, on the other hand, the quantity of progeny is strictly related to fertility, which may be defined as the production rate of “expensive” egg cells. In the case of females, the optimal number of copulations is significantly lower than in males because every sexual encounter carries the risk of infection, of a predator attack during the sexual act itself, or may simply be a waste of time and energy. Therefore, the quantity of partners is not important to the female – what counts is quality. A strong and fit male will guarantee good genes for his progeny, provide security, care for the offspring, and guarantee access to resourceful territories. What is more, females would avoid too many copulations. Hence, females – and more precisely their egg cells – become a scarce resource which is fought over by the males. Natural selection favors adaptations

that ensure success of the fittest males – sometimes even to the detriment of the female.

Evolutionary tug-of-war

Since males strive for the greatest possible number of successful sexual acts, they develop traits enabling them to incite or simply force their female partner to copulate. Females, on the other hand, develop various counter-adaptations protecting them from being manipulated or forced on by males. The benefits from sexual intercourse are much smaller to females, and the sexual act itself is costly. Resistance of female partners is not welcomed by males, so in response to it they develop subsequent adaptations to overcome it. And so on.

In many species, the conflict between genders about frequency of copulations has resulted in the development of strange morphological structures which serve the purpose of holding the female and forcing her to have sex. Such “instruments” most frequently occur in insects; however, forced sexual acts also take place in other animals. For example, when a male duck is ready to have sex, he attacks the female and uses his beak to hold her down. The fight is usually joined by other males, frequently with disastrous consequences to the female. It is estimated that violent sexual intercourse is the cause of 7-10% of deaths among duck females! However, the most extreme example of brutal sex is to be found in the so-called traumatic insemination in bed bugs. The male pierces the female’s body and injects his sperm directly into the hemolymph (the fluid that arthropods have in their circulatory system), through which it travels to the female’s ovaries. Such insemination is harmful to the female, which experiences loss of hemolymph and runs the risk of an infected wound. Therefore, in the course of evolution females have developed various ways of dealing with the crude actions of their male partners. Certain species even have specialized reproductive organs known as “paragenitalia” at the site of penetration.

Sperm wars

But the clash of the genders doesn’t end with copulation. Immediately after the sexual act, the female’s reproductive tract becomes a battleground, the scene of a fierce battle between the sperm of different partners (as in many species the female copulates with more than one male). In response, males have a tendency to increase the size of their testicles, produce large quanti-



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Traumatic insemination in *Cimex lectularius* bed bugs. The male pierces the female's body and injects his sperm directly into her cavities

ties of quickly moving sperm, and arm the ejected material with substances that destroy or remove the previous partners' sperm from the female's reproductive organs. In the common fruit fly, researchers have identified as many as 140 different proteins produced by the male reproductive glands.

And these "sperm wars" are not without an impact on the females. For example, the substances found in the seminal fluid of fruit fly males, which are meant to increase their chance of successful insemination, are also toxic to the female. They also contain ingredients that stimulate the females to produce greater number of eggs, which has an adverse effect on her future reproductive capacity. These substances also alter the females' behavior in ways that are advantageous to the males.

In many animal species, such sperm wars have also affected the appearance of the reproductive organs. They have evolved special structures resembling hooks or spines, which enable them to remove the competitors' sperm from the female body. These structures may damage the female reproductive tract, and several such copulations may shorten the female's lifespan.

Reproductive calculation

Although it is commonly thought that the structure of male copulative organs and toxicity of their seminal fluids are side effects of such sperm wars, there is also a hypothesis (so far without strong proof) that damaging the female's body might in itself be advantageous to the male. Any harm inflicted on the female affects her longevity. The female, facing the prospect of imminent death, will invest all her resources in the offspring resulting from the very act of copulation that is so detrimental to her. Hence, the male will obtain a greater number of progeny from a brutal act. Moreover, the wounded female will abstain from further sexual activity. This, in turn, lowers the risk that the sperm will be defeated by the seminal fluids injected by another partner. ■



The penis of the bean weevil *Callosobruchus analis*, fitted with hooks to hold the female

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Further reading:

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