Male animals are subject to stronger evolutionary pressures than females

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Male animals are subject to stronger selection pressures than females, which may allow populations to adapt to environmental change more efficiently, according to a report published in the open-access journal

eLife.

The study supports one of the long-standing assumptions underpinning the idea that sexual selection bolsters adaptation: that stronger selection on males allows them to purge the population of genetic mutations that reduce survival fitness.

Sexual selection is selection arising from competition for mating partners and/or their reproductive cells (their eggs or sperm). For almost a century, researchers have thought that sexual selection is the ultimate selective force that generates the differences we see between male and female animals in terms of reproductive fitness and life history. Yet, little is known about how sexual selection combines with other environmental pressures to impact population demography and adaptive ability.

Living organisms accumulate mutations throughout life—some of which help them become fitter for survival, and some of which provide no benefit and may even cause a disadvantage (called deleterious mutations). Sexual selection is thought to promote evolutionary adaptation if it gives rise to stronger net selection—that is, the total purifying selection against deleterious mutations—in males rather than females. This is because a population's productivity relies on females' ability to reproduce, so that stronger net selection on males allows a population to get rid of the deleterious mutations quickly and adapt to their environment with a lower cost to the population, which may eventually reduce the risk of extinction.

"Our knowledge on whether such stronger sexual selection on males translates into stronger net selection to females is still limited," says first author Lennart Winkler, a Ph.D. student at TU Dresden, Germany. "Previous studies have used the phenotypic variance of fitness to measure net selection, but its relevance has been questioned. An

alternative measure is the organism's genetic variance of fitness. We used both measures to show whether net selection is generally stronger on males across a broad range of species."

The team ran a systematic literature search and compiled 101 paired estimates of male and female genetic variances across 26 species for two important components of an organism's fitness: reproductive success and lifespan.

They then tested whether the phenotypic variances were aligned to the genetic variances, and whether genetic variances show consistent sex differences. They predicted that males would show larger genetic variance in reproductive success but not in lifespan.

They found that the phenotypic variance of lifespan but not of reproductive success predicted the genetic variance in either males or females. Importantly, however, the phenotypic variance of reproductive success was larger in males than females, and this translated into a male bias in genetic variance. This sex difference could be detected in polygamous but not monogamous species. By contrast, there were no consistent sex differences in phenotypic or genetic variance for lifespan.

"Our results have two major implications," says senior author Tim Janicke, a researcher at the Centre d'Ecologie Fonctionnelle et Evolutive in Montpellier, France. "First, phenotypic variance of reproductive success is a poor predictor of purifying selection against deleterious mutations. Second, our findings provide support for the prediction that net selection is generally stronger on males compared to females, which may not only bolster local adaptation but can also reduce the risk of extinction when populations face challenging environmental conditions. Therefore, our results support the idea that sexual selection can play a pivotal role in evolutionary rescue."

More information: Lennart Winkler et al, Stronger net selection on males across animals, *eLife* (2021). DOI: 10.7554/eLife.68316

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