Published in Academia Letters 12 May 2022
https://doi.org/10.20935/AL5300

A historical confusion that has long permeated the sex paradox

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#mathematical biology, #fundamentals of biology, #history of biology, #history of science, #sex paradox

Abstract

A historical misunderstanding permeates nearly every formulation of the sexual reproduction paradox, an age-old conundrum that continues to challenge the foundations of evolutionary theory. Recognizing this error will clarify the problem and facilitate its resolution.

"Nothing in Biology Makes Sense Except in the Light of Evolution" — Theodosius Dobzhansky[1].

Introduction: The Paradox

In 1862, Charles Darwin wrote, “We do not even in the least know the final cause of sexuality; why new beings should be produced by the union of the two sexual elements, instead of by a process of parthenogenesis”[2], expressing for the first time a puzzle that still resists a definitive explanation.

Darwin’s words underscore the conclusion that “one of the most enduring puzzles in evolutionary biology is why sexual reproduction is so widespread.” It has even been described as “the major paradox of evolutionary theory — the ‘queen of problems in evolutionary biology’” [3], [4].

Such beliefs were published a few years after G. C. Williams opened a publication stating: “This book is written from a conviction that the prevalence of sexual reproduction in higher plants and animals is inconsistent with current evolutionary theory”[5] reflecting a strong evolutionary judgment on the paradox.

Since then, for over a century, a definitive explanation for the selective advantage of sexual reproduction has not yet been established, although sex is so phylogenetically widespread that it indicates that its evolutionary success must be explained by a simple, general advantage[6].

A Historical Confusion

In 1958, Maynard Smith made a serious mistake that continues to confuse analyzes of the paradox of sexual reproduction when he wrote:

> If the rate of increase of an animal population were limited by the number of eggs which each female could lay, which in turn depended on how much food a female could eat and transform into eggs, then a population consisting entirely of parthenogenetic females would increase twice as fast as would a population of equal numbers of males and females.[7] (my emphasis).

The serious misconception highlighted above stems from a failure to recognize the profound difference between "twice as fast" and "twice as fast per generation." At first glance—especially for those unfamiliar with mathematical reasoning—the two expressions may seem similar, differing only in nuance. However, they are not! Maynard Smith's formulation implies that, after ten or twenty generations, asexual populations will be twice as numerous as sexual ones. The correct formulation, however, predicts a population a thousand times greater for asexual populations after ten generations and a million times greater after twenty generations!

The mistake may have been necessary to support the precarious explanations for the existence of sex that are currently in vogue. It is doubtful that any of these explanations would withstand scrutiny if such numbers were emphasized. In light of this correction, they all seem incapable of counterbalancing a mechanism that reduces the number of descendants to one thousandth every ten generations.

The error went unnoticed and was repeted by virtually all subsequent authors, as can be seen, for example, in a correspondence from Michael Ghiselin to George C. Williams, where he states "You have assumed that a parthenogenetic form would have **twice as many offspring** as a sexual one"[8] (my emphasis). In this instance, both seminal authors commit the same error made by Maynard Smith[9].

Discussion

These are historical facts that can be witnessed in any book addressing the sex paradox, where the same error is found at least implicitly. It is likely that the correct formulation of the paradox has never been explicitly stated in a publication, attesting that the error is present not only in words, but in the minds of evolutionist authors, though, if questioned, they would all agree that the expression was incorrectly formulated.

The repetition of such a fundamental error cannot be dismissed as a mere oversight. It illustrates how deeply evolutionary authors have indulged in a misconception that, if made explicit, would clearly reveal the misunderstanding ingrained in their thinking, as well as the significant consequences that arise from it.

The mistake is simple enough to be understood by anyone with basic mathematical skills. The correction of this error is as straightforward as its recognition, leaving no reason for it not to be addressed urgently.

The words of C. G. Williams quoted below were not chosen lightly to open his book: "prevalence of sexual reproduction in higher plants and animals is inconsistent with current evolutionary theory"[5]. The gravity of such a conclusion compels us

not only to recognize the error, but to resolve the paradox of sexual reproduction at a proper formulation, highlighting the enormous progressive growth from generation to generation embedded in it.

Conclusion

The historical error explained above has been around for too long. It needs to be recognized and corrected urgently.

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