

# What constitutes a paradigm shift? An olive shrub's mating system as a case study of Kuhn's theory

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Philosopher Thomas Kuhn's influential theory of how scientific knowledge is built introduced the term "paradigm shift" to explain a

transformation of a field's ideas and methods. "A Paradigm Shift, or a Paradigm Adjustment? The Evolution of the Oleaceae Mating System as a Small-Scale Kuhnian Case Study," a new paper published in *The Quarterly Review of Biology*, seeks to apply this analytical framework to a small controversy in population biology: the mating system of the shrub *Phillyrea angustifolia*.

Traditional theory states that the sex ratio of a population should be 1:1 male to female (or highly skewed towards hermaphrodites in male-[hermaphrodite](#) populations). But natural populations of *P. angustifolia*, a shrub in the olive family native to the Mediterranean, have unexpected high frequencies of males, note authors Alexandre Francq, Pierre Saumitou-Laprade, Philippe Vernet, and Sylvain Billiard.

Several possible solutions were floated to resolve this paradigm crisis. One postulated that hermaphroditic individuals were functionally female. Another suggested that a mechanism known as self-incompatibility made it so pollen emitted by males was more successful at fertilization than pollen emitted by hermaphrodites (and also eliminated the advantage of self-fertilization in hermaphrodites).

The issue was ultimately resolved with the discovery of the link between a distortion segregation biased towards males and a diallelic self-incompatibility system, which advantaged male reproductive fitness. "Hermaphrodites can reproduce through their ovules and pollen, while males can only reproduce through their pollen, but hermaphrodites can only sire approximately one-half of the hermaphrodites ... while males can sire all hermaphrodites," the authors explain.

Francq, Saumitou-Laprade, Vernet, and Billiard use several criteria to analyze if this discovery and change comports to Kuhn's theory and represents a true paradigm shift, or only a paradigm adjustment. While the question of *P. angustifolia*'s [sex ratio](#) is a small one, the authors

conclude it is indeed an example of an anomaly and associated crisis, central concepts in Kuhn's theory.

And while the discovery "did not change anything to the way most biologists of evolution practice science, it drastically changed the way groups dedicated to plant mating systems pursued their research."

The question also embodies several examples of what Kuhn called the incommensurability of paradigms. These include the possibility that the same hermaphroditic *P. angustifolia* plant could be considered functionally as a female, in one paradigm or true hermaphrodites, in another, and the fact that different specialty fields studying the problem were too distinct from each other and unable to operate on common ground, the authors say.

Resistances to the shift also arose after the discovery of the mating system, an inherent component to Kuhn's theory, and the authors also discuss possible future challenges to the new paradigm.

Ultimately, the authors conclude that the discovery of the diallelic self-incompatibility system in *P. angustifolia* does indeed fulfill the conditions necessary to constitute a paradigm shift.

"Overall, a Kuhnian analysis of this small-scale case study offers a unique opportunity to analyze how science works in action, study some phenomena that are rarely observed for high-level paradigms (e.g., scientists' conversion from the old to the new [paradigm](#)), and thoroughly analyze the roles played by the confrontation between models and data in a [paradigm shift](#)," the authors write.

**More information:** Alexandre Francq et al, A Paradigm Shift, or a Paradigm Adjustment? The Evolution of the Oleaceae Mating System as a Small-Scale Kuhnian Case Study, *The Quarterly Review of Biology*

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