# Some worms programmed to die early for sake of colony

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Caenorhabditis elegans. Credit: Wikipedia

Some worms are genetically predisposed to die before reaching old age, which appears to benefit the colony by reducing food demand, finds a new UCL-led study.

The modelling study, published in *Aging Cell*, provides the first evidence of programmed, adaptive death in an animal that has evolved due to the benefits to the community.

Lead author Professor David Gems (UCL Institute of Healthy Ageing) said: "According to evolution theory, altruistic death to leave more food to your relatives normally can't evolve. This is because other individuals who live longer would consume resources left behind by altruistic comrades and outcompete them, in what's called a tragedy of the commons.

"But it was recently discovered that wild *C. elegans* roundworms live in colonies of identical worms, which would prevent long-living worms with different genes from taking over."

The researchers explain that evolutionary theorists originally believed that ageing evolved to reduce the population in order to increase food availability for the young, but scientists have since shown this cannot be true for most animal species as longer-lived non-altruists would usually be favoured by natural selection.

However, certain organisms possess what appear to be self-destruct programmes, preventing them from living beyond a certain age. For example, in the tiny roundworm *C. elegans*, mutations to particular genes can massively increase their lifespan, presumably by switching off the life-shortening programme.

In the current study, UCL researchers investigated the specifics of the *C. elegans* life cycle to understand why programmed death may work for them, by devising computer models of a *C. elegans* colony growing on a limited food supply. They tested whether a shorter lifespan would increase the reproductive capacity of colonies, by generating the equivalent of colony seeds (a dispersal form of worm called a dauer).

They found that shorter lifespan, as well as shorter reproductive span and reduced adult feeding rate, increased the reproductive success of the colony.

First author Dr. Evgeniy Galimov (UCL Institute of Healthy Ageing) said: "It's been known for years that programmed cell death benefits living organisms, but we're now realising there is programmed organismal death as well, that can benefit animal colonies."

The findings have major implications for studies of the biology of ageing, much of which is conducted using *C. elegans*. Other animals have genes similar to the lifespan-shortening worm genes that promote late-life disease, so a greater understanding of the genes' function could contribute to medical research.

But the researchers caution that their latest findings are specific to worms whose life cycles are suited to such an adaptive mechanism.

Professor Gems said: "Our findings are consistent with the old theory that ageing is beneficial in one way, as they show how increasing food availability for your relatives by dying early can be a winning strategy, which we call consumer sacrifice. But adaptive death can only evolve under certain special conditions where populations of closely related individuals don't mix with non-relatives. So this is not predicted to apply to humans, but it seems to happen a lot in colonial microorganisms."

Dr. Galimov continued: "It appears possible that adaptive death could happen in some types of salmon, which spawn and die in huge numbers in the upper reaches of rivers. It's been shown that the rotting, dead salmon nourish the salmon fry. We call this form of adaptive death biomass sacrifice."

The work illustrates how reducing evolutionary fitness of individuals can increase the fitness of communities in organisms that live in colonies.

The authors say the next stage in their work is to study actual *C. elegans* colonies to test for behaviours predicted by the model, and then use that knowledge to build more realistic models to understand adaptive death.

**More information:** Evgeniy R. Galimov et al, Shorter life and reduced fecundity can increase colony fitness in virtual Caenorhabditis elegans, *Aging Cell* (2020). DOI: 10.1111/acel.13141

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