Scientists sequence asexual tiny worm—whose lineage stretches back 18 million years

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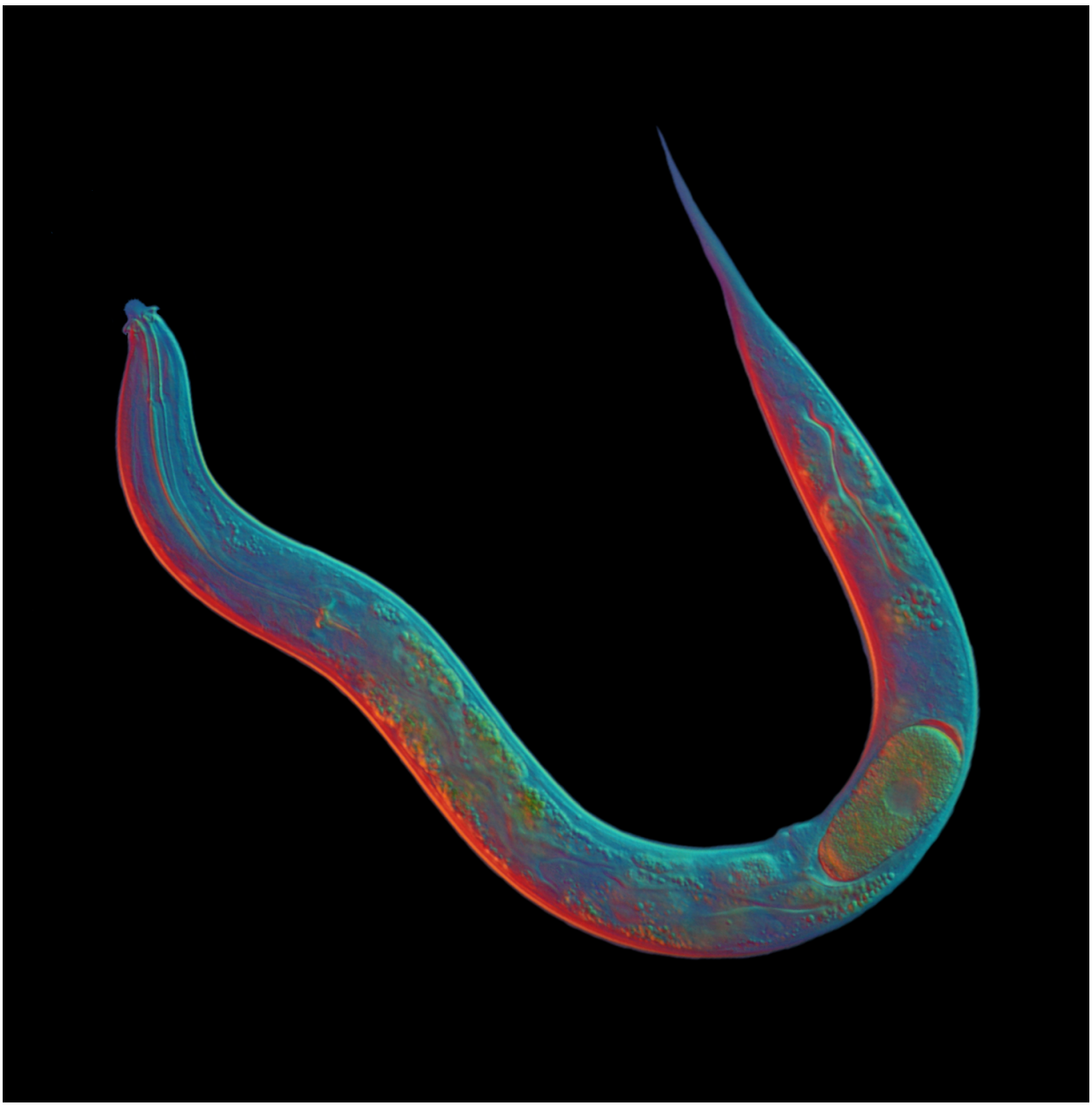

Diploscapter pachys (*D. pachys*), a newly sequenced roundworm that is approximately one-third of a millimeter long and one of a very few known animals that have only a single chromosome. Credit: Karin Kiontke and David Fitch.

A team of scientists has sequenced, for the first time, a tiny worm that belongs to a group of exclusively asexual species that originated approximately 18 million years ago—making it one of the oldest living lineages of asexual animals known. The work reveals how it has escaped the evolutionary dead end usually met by organisms that do not engage in sex.

"Scientists have been trying to understand how some animals can survive for millions of years without sex because such strict, long-term abstinence is very rare in the animal world," explains New York University Biology Professor David Fitch, one of the co-authors of the research. "This phenomenon is a significant one in understanding evolutionary genetics because it runs counter to the widely accepted view that sexual reproduction is required to eliminate deleterious mutations and for adaptation to a changing environment."

"For example, in the short term, inheriting copies of both parents' genes usually provides good insurance against mutations that might kill the function of one of those gene copies—a process called complementation," Fitch continues. "In the long term, producing offspring via intercourse allows for adaptation to changing conditions over time because it produces variation through genetic shuffling, or recombination. However, because such shuffling does not occur within asexual species, they tend to go extinct rapidly. So, it has been a

longstanding mystery in biology how some asexual animals have survived for so many generations."

The research, conducted by researchers in NYU's Center for Genomics and Systems Biology and Duke University's Center for Genomic and Computational Biology, appears in the journal *Current Biology*.

The newly sequenced worm, *Diploscapter pachys*, is a tiny, transparent, free-living roundworm and closely related to *Caenorhabditis elegans*, an organism commonly used for biomedical research.

Unlike *C. elegans*, however, *D. pachys* is asexual.

In making this determination, the scientists used DNA to derive a genealogy that revealed D. pachys belongs to a group of exclusively asexual species that originated approximately 18 million years ago.

In a closer examination of how *D. pachys* reproduces, the research team found that, like many other asexual organisms, the process of making germ cells—sperm or ova—had been modified to prevent recombination, or the reshuffling that results from sexual reproduction.

"Basically, the animals were cloning themselves," explains Fitch. In addition, when the researchers studied its chromosomes, they found something even more surprising: there was only one pair of chromosomes.

Close relatives, such as *C. elegans*, have 5-7 chromosomes, but a single-chromosome pair, the scientists say, is so rare in higher organisms that only two other animal species are known with this condition: an ant and a parasitic roundworm.

The researchers decided to sequence the genome of *D. pachys* to test

how the single chromosome was structured, whether by loss or by fusion of multiple ancestral chromosomes.

Their results showed that *D. pachys* fuses the six chromosomes of its ancestor into a single chromosome and skips the first division of meiosis, where genes are recombined, so that its offspring keeps the high genetic diversity of the parents.

"Thus, the mystery of its longevity seems largely resolved: *D. pachys* overcomes the disadvantages of asexual reproduction by maintaining genetic variation, and with it, complementation," explains Fitch. "Ironically, this is accomplished by making sure there is no recombination between the gene copies. If there were, the differences between the gene copies might be lost. In fact, *D. pachys* has gotten rid of several of the genes required to make the recombination machinery that exists in sexual organisms."

Provided by New York University

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