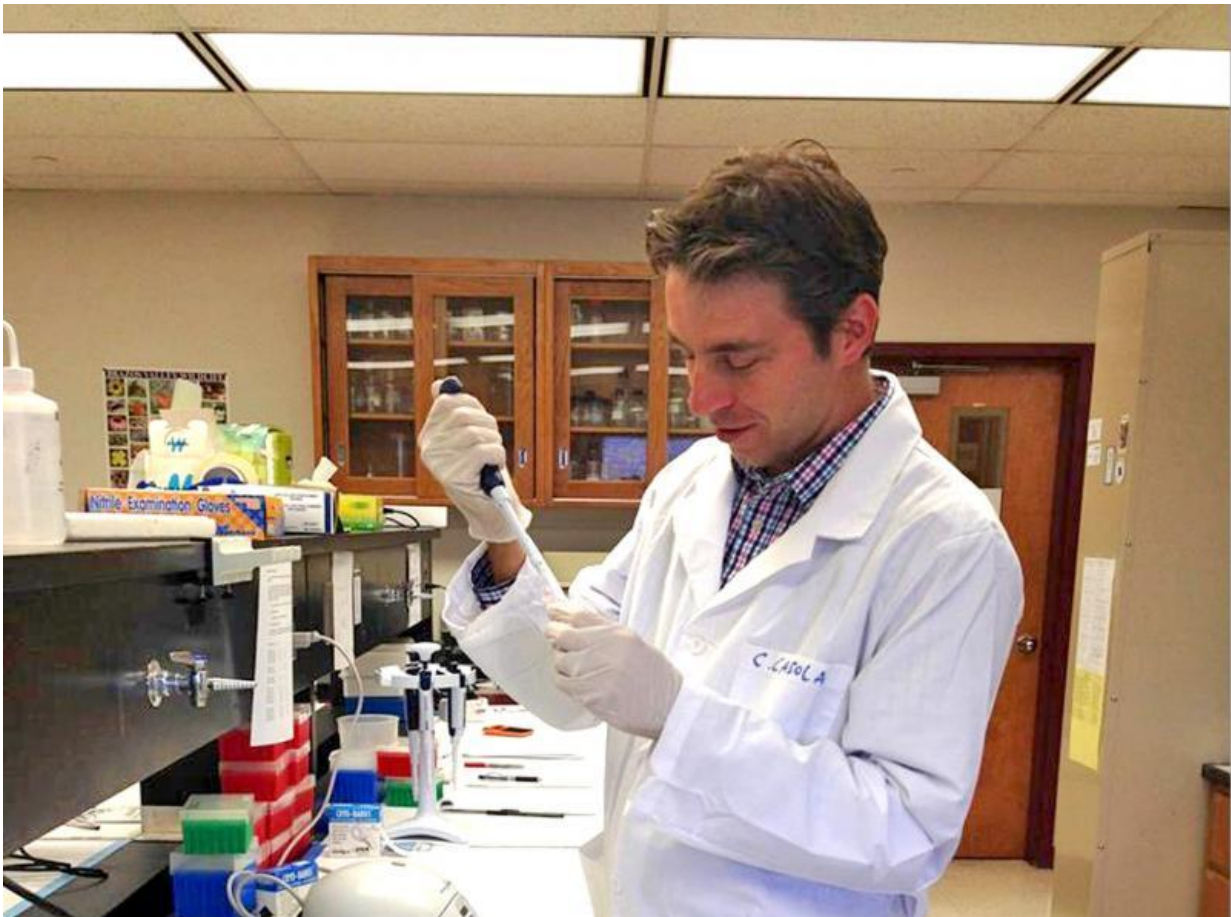


Scientists document rare DNA transfer between animals and plants

April 14 2016, by Kay Ledbetter



Dr. Claudio Casola, a Texas A&M AgriLife Research forest genomics assistant professor, and his team documented a natural DNA transfer between animals and plants. Credit: Texas A&M AgriLife Communications photo

Very few cases of natural DNA transfers between animals and plants are documented, according to a Texas A&M AgriLife Research scientist, but recently his team did just that.

The research team found a group of DNA sequences in pine trees, spruces and other conifers had been transferred to an ancestor of those trees from insects about 340 million years ago, said Dr. Claudio Casola, an AgriLife Research forest genomics assistant professor in the Texas A&M University ecosystem science and management department in College Station.

"Loblolly pine is an important economic resource across the southeastern U.S., including Texas," Casola said. "We are just now starting to understand the different parts that form the very large genome of this pine tree and other conifers.

Xuan Lin, one of Casola's doctoral students, and Dr. Nurul Faridi, leader of the U.S. Department of Agriculture Forest Service's Molecular Cytogenetics Laboratory and a collaborating faculty member, were other members of the team.

Their work, "An Ancient Trans-Kingdom Horizontal Transfer of Penelope-like Retroelements from Arthropods to Conifers," was published recently in the *Genome Biology and Evolution* journal.

"We called these conifer DNA sequences 'Dryads' after the Greek mythological nymphs that inhabit trees," Casola said. "Dryads are one of the many groups of DNA sequences known as DNA repeats."

He said DNA repeats, also known as transposable elements, are particularly good at making new copies of themselves. As a result, they ended up forming more than half of the genome in some species, including conifers and other plants.

"We know from studies in other plants that transposable elements affect both the activity and the structure of genes, and ultimately have a role in shaping certain traits, from the color of some grape varieties to the oval shape of some tomatoes."

He said because transposable elements make up a lot of the conifers' DNA, it is important to gather a better understanding of what they are and how they influence conifer genes and phenotypic traits.

"You can think of transposable elements as 'genomic parasites,'" Casola explained. "They spread into new genomes kind of like viruses spread between people. Unlike flu and other viral disease, these 'genomic infections' occur rarely, but once established, they can persist for millions of years."

The similarities between some transposable elements and viruses are not only superficial, he said. For example retroviruses, the group of viruses that includes the HIV, evolved from transposable elements long ago.

On the other hand, Casola said, many transposable elements known as endogenous retroviruses, or ERVs, represent "DNA fossils" of retroviruses that once infected primates and other mammals.

"No less than 8 percent of our own genome is made of ERVs," he said. "Retroviruses, ERVs and other DNA repeats such as Penelope-like sequences share a unique way to make new copies of themselves."

In this process, a single DNA repeat acts as a template to make many molecules called RNAs, and these RNAs are then transformed back into just as many DNA copies that are sort of stitched back in the host genome, he explained.

Because the generation of new DNA copies from RNAs is called

retroposition, transposable elements that amplify through this mechanism are known as retroelements, Casola said. By looking at some specific features in the DNA of retroelements, it is possible to classify them into different families and subfamilies.

"Dryads represent a conifer-specific subfamily within the larger family of Penelope-like retroelements, hence the manuscript's title," Casola said. "Before we described Dryads, Penelope-like retroelements were known only in animals.

"We thought that Dryads could have derived from Penelope-like retroelements that were somehow introduced into conifer genomes long ago," he said. "To confirm that, we computationally analyzed the genome sequences from 1,029 species that were neither animals nor conifers.

"Some of these other species seemed to contain Penelope-like retroelements; however, after thorough inspections of these DNA sequences, we concluded that they were due to DNA contamination from either [animals](#) or conifers."

Casola said they also did a lot of other analyses to confirm that Dryads are not artifacts and to show they are likely derived from insect Penelope-like retroelements.

"One of the techniques used is called fluorescence in situ hybridization, or FISH, and allowed to visualize the position of Dryad DNA sequences on the loblolly pine chromosomes," Faridi said.

Other lab experiments showed that Dryads do not occur in plants closely related to conifers, such as cycads and ginkgo, he said.

"This helped us in timing the origin of Dryads between the separation of

conifers' ancestors from other plants and the radiation of modern conifer groups known to have occurred about 340 million years ago," Casola said.

The consequences of Dryads invasion for conifers evolution remain unclear, he said.

When DNA repeats like Dryads amplify in a genome, they can change the structure of chromosomes and alter the activity of genes, with potential negative consequences for the organism, Casola said.

Most species have evolved genetic mechanisms that slow down the amplification of DNA repeats, but when they jump into new host genomes, these defense mechanisms are not in place yet and a new cycle of amplification ensues, he said.

The same likely happened in Dryads, which generated hundreds of thousands of new copies in the past 340 million years but now seem to have a relatively low activity, at least in loblolly pine, Casola said.

"We think that Dryads changed significantly the genome landscape of ancestral conifers and possibly are still introducing important changes into the DNA of these trees," he said.

"The next step in our research will be to understand how conifer chromosomes, and especially genes, were affected by the amplification of Dryads since their invasion of these [plants](#)," Casola said.

"Additionally, we want to know if Dryads and other DNA repeats show differences between loblolly pine trees that are associated with trait differences, for example drought tolerance and pest resistance. Both these aspects will be the focus of future research in our labs."

More information: Xuan Lin et al. An Ancient Trans-Kingdom Horizontal Transfer of -like Retroelements from Arthropods to Conifers , *Genome Biology and Evolution* (2016). [DOI: 10.1093/gbe/evw076](https://doi.org/10.1093/gbe/evw076)

Provided by Texas A&M University

Citation: Scientists document rare DNA transfer between animals and plants (2016, April 14)
retrieved 26 April 2024 from
<https://phys.org/news/2016-04-scientists-document-rare-dna-animals.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.