Researchers map 'fly tree of life'

March 14 2011

Calling it the "new periodic table for flies," researchers at North Carolina State University and collaborators across the globe have mapped the evolutionary history of flies, providing a framework for further comparative studies on the insects that comprise more than 10 percent of all life on Earth.

The research, published today in the online edition of Proceedings of the National Academy of Sciences, plugs gaps in the 260-million-year history of the fly order Diptera, says Dr. Brian Wiegmann, NC State professor of entomology and primary investigator of the fly tree of life project. While providing the most comprehensive picture of fly life over the ages, the tree should allow scientists to tease out answers to other puzzling questions about flies, like how some traits, such as blood feeding, appeared and reappeared many times across millions of years of evolution. The results of future studies based on the information provided by the tree may have important impacts on human health and the environment; flies have a substantial impact on society as vectors of killer diseases like malaria, as agricultural pests, and as important pollinators and decomposers.

“Flies have a long history of evolutionary success in all sorts of environments,” Wiegmann says. “For example, there are fly larvae that live in petroleum, in hot springs, in the gills of land crabs, on the dung of millipedes and within bee hives. The fly tree of life allows us to learn more about both the pattern and the process of evolutionary change, and to make predictions about new discoveries.”

Using the most complete set of fly genetic and structural anatomy data ever collected, the paper shows that members of the oldest, still-living fly families are rare, anatomically strange flies with long legs and long wings that grow up in fast-flowing mountain waters.

“Flies' origins and evolutionary history began in wet environments,” Wiegmann says. “As flies diversified, they became more well-suited to terrestrial life. In general, they have flexible life histories that have allowed them to flourish in opportunistic ways.”
Life on Earth has emerged in bursts of diversification, and fly evolution mirrors this process: flies became more diverse in three large episodes occurring at 220, 180 and 65 million years ago. Just as dinosaurs were becoming extinct, flies and moths were experiencing the largest diversification of animals that has occurred in the past 65 million years. The paper also shows the number of times that different fly lifestyles evolved; there are 12 different and independent occasions when flies began feeding on blood, for example, and 18 times when, ironically, flies lost their wings.

Some results were surprising. The study showed that the nearest relatives of Drosophila, the fruit fly that many key scientific discoveries have been based on, are two unusual parasites: bee lice, wingless flies that live on honey bees; and Cryptochetidae, flies used as biological controls of crop pests.

“Flies are more ecologically diverse than any other organism,” Wiegmann says. “There are so many different kinds – 152,000 named species – and they do so many different things that they’ve been a particularly difficult puzzle for scientists. We still haven’t found all the flies that exist, so there are still some surprises out there. But this work unlocks some of the mysteries of the fly evolutionary tree and adds a major branch to the tree of life for all living things.”

More information: “Episodic Radiations in the Fly Tree of Life", Brian Wiegmann Michelle Trautwein, Isaac Winkler, Norman Barr, Jung-Wook Kim, Matthew Bertone, Brian Cassel, Keith Bayless, North Carolina State University, et al. Published on March 14, 2011, online in *Proceedings of the National Academy of Sciences*.

Provided by North Carolina State University