Marsh Madness

FINDING CLUES TO HUMANITY'S PAST AND FUTURE IN A SEA ANEMONE

BY BARI WALSH

A PEACOCK, a Wall Street trader, a stalk of celery, the virus that caused your winter cold. The variety of life on Earth is astounding — and one of the least understood phenomena in all of biology. As worries grow about the pace of extinctions and threats to biodiversity, figuring out how and why species evolve (or don't) in so many different ways has taken on a new urgency.

Could a tiny and humble sea anemone from the salt marshes of New England deliver some answers? John Finnerty thinks so. His biology lab at Boston University has become internationally known as a center of research into an important new model animal for evolutionary study, the *Nematostella*, or starlet sea anemone — an elegant name for a wisp of a creature the size of a grain of rice. In the lab and in its native estuaries, *Nematostella* offers a fresh angle on the evolutionary development of humans and on the effects of climate change.

Finnerty's team attempts to explain biodiversity by comparing animal genomes and pinpointing areas of "novelty and innovation" — points at which one genome is not like another. In seeking to understand what makes humans human, for example, the researchers look at the genomes of simpler creatures and try to identify the variations that ultimately led to human complexity.

Biologists have generally assumed that "there were going to be lots of innovations in the human genome that make us complex," says Finnerty, a College of Arts and Sciences assistant professor of biology. "The first animal genomes we compared ourselves with were *Drosophila* [the fruit fly] and nematode [the roundworm]. Certain genes were present in us and absent in them, and so the assumption was that these might be some of the inventions that helped make us who we are."

The fruit fly and the worm, two of the most common model organisms in biology, provide a glimpse back in genetic time to an early stage in animal evolution, Finnerty says, but the sea anemone "takes us to an earlier point in time." It shares 80 percent of our genes, including "some really interesting animal-specific traits," like nerve cells, muscle cells, and even signs of a bilateral body plan, as Finnerty first reported in *Science* in 2004, something long thought to be the exclusive domain of so-called higher animals.

"Some of the things that we thought were human inventions, because they were missing in the fruit fly and the nematode, were actually present in *Nematostella*," says Finnerty. "That suggests that not only are those genes not human inventions, but that they trace their legacy way back in animal evolution — that the basic animal blueprint may be very, very old."

This odd, tiny creature contains a gene involved in breast cancer, "which just blows people's minds."
—John Finnerty

In a 2007 article in the journal *Genome*, Finnerty and his former doctoral student James Sullivan (GRS'08) report that an unexpectedly high proportion of human disease genes are present in this simple animal. "It turns out, for example, that there's a really good representative in *Nematostella* of one of the genes involved in breast cancer," Finnerty says. "That just blows people's minds, because that's a very mammalian disease. But this is a gene that has an ancient history, and sometimes understanding the history can help inform the medical studies. You can look at how the gene evolved across hundreds of millions of years and say, *that* particular change really stands out, and let's investigate whether that might be important."

It's not only the ancient lineage of the animal that holds Finnerty's interest. He's looking now at finer-scale genetic variations within *Nematostella* populations, measuring how different groups react to environmental stresses. "*Nematostella* live in estuaries, which are really at the crosshairs of a lot of the impacts we make on the planet. These guys are like the canary in the coal mine," he says.

With his students, he's comparing animals from South Carolina, New Jersey, Massachusetts, and Nova Scotia, finding that "some can grow faster at higher temperatures, or they can regenerate faster at higher temperatures, and that's of course very relevant for climate change.

"We think these guys live under the mantra 'adapt or die,'" Finnerty says. "They can't really move north with increasing temperatures, as we believe some species are doing, like the maples in Vermont. We think it's a great model to understand how other animals might adapt."

PHOTOS BY VERNON DOUCETTE

In Sippewissett Marsh on Cape Cod, John Finnerty (right) searches for *Nematostella* with (from left) Adam Reitzel (GRS'08) and doctoral student Derek Stefanik.