Modern computers to uncover secrets of Duke’s ancient mosses

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It’s ironic. The 230,000 specimens of bryophytes -- mosses and their cousins-- in the Duke Herbarium’s massive collection may have evolved some 500 million years ago. But not until 21st-century computer technology will some of their secrets be revealed.

Until now, access to the rich trove of specimens has been limited because they have been catalogued only in paper records. However, a $400,000 grant from the National Science Foundation will enable a team of technicians to scan images of the specimens and code data on them into an online database available around the world.

Duke students can access the database for evolutionary and biological studies in their coursework, and faculty can use the database to find specimens for their research. It’s a rich scientific trove, says biologist Jonathan Shaw, curator of bryophytes.

Our bryophyte and lichen collections are two of the most important and largest in the country," he said. "The bryophytes are probably one of the largest three university-based collections of bryophytes. We have, of course, the best collection of North Carolina mosses in the world, and North Carolina moss diversity is extremely high. A significant percentage of all the species that are present in North America are present in the southeastern United States.

"We also have several hundred ‘type’ specimens, which are those on which new species are based. These are critically important, because they define a species, which really cannot be done from written descriptions or photos," he said.

Modest-looking little plants that nestle in the moist soils of swamps or mountain hollows, mosses fascinate biologists both because of their evolution and their biology, said Shaw.

For one thing, North Carolina is a sort of "Lost World" of plants -- where plants from regions much farther north or south have somehow survived for millennia.

"Here in North Carolina, we have species that are reaching their northern limit from the tropics," he said. "And we have boreal species from the far north that reach their southern limit in the mountains of North Carolina." Shaw recalls that this strange juxtaposition can yield surprises.

"About eight years ago, I was collecting bryophytes in some of the very rich gorges of the Appalachians in southwestern North Carolina. I was just making general collections, and I picked up one moss that didn't look like any great shakes. But it turned out that it was the first population of this moss found in North America. And the next closest locality for this species was in Guatemala."

Besides giving scientists more ready access to the collection, computerization will also enable Duke bryologists to identify "hot spots" of moss diversity that should be conserved, as well are "dark spots" of regions that are undercollected.

"The mosses are a really biologically important group of plants because they're very primitive land plants," said Shaw. "So, studies of mosses can help us understand the origins of biodiversity. They're also starting to become more and more important model organisms for the study of molecular genetics and genomics."

Shaw explained that mosses are especially amenable to genetic tinkering because their adult form contains only one copy of each gene -- a state called haploidy. By contrast higher organisms, from vascular plants to humans, are "diploid," containing two copies of each gene.

"This haploid property of the moss genome has implications both scientific and practical," said Shaw. "In terms of studying evolutionary processes, there is less hidden genetic variation, because there aren't two copies of each gene. When a mutation arises in a moss species, it is either going to be selected or not by the environment, unless it's absolutely neutral. This phenomenon allows us to use mosses to understand evolutionary processes in a way that no other group of organisms allows.

"This haploidy also lets us alter or knock out genes and see their effects right away, because there are not second copies to mask the alteration," he said. Using mosses in such studies, said Shaw, will aid in mapping the location of genes of ecological or developmental importance to plants, as well as exploring how multiple genes interact in influencing plant development.

Source: Duke University

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