Extracts

DNA-Reading Tool Helps Quickly Identify Species

Within a decade, scientists may be able to use a handheld device to instantly identify any species from a snippet of animal tissue, says a University of Florida researcher.

That may be possible thanks to scientific advances that include the first test quantifying the effectiveness of a DNA identification tool among brightly colored shells.

With an error rate as low as 4 percent, two UF scientists have been able to identify cowries collected from around the world by analyzing tissue samples from the marine organisms and comparing them to a comprehensive catalog of species they compiled.

The findings were published in the December issue of *PLOS Biology*.

"DNA barcoding — the ability to take a remnant of animal tissue or blood and compare it with a known database — has attracted widespread attention with its promise as a valuable aid in species identification and discovery," said Christopher Meyer, a UF biologist and one of the researchers. "However, few comprehensive data sets are available to test its performance. This is the first study to actually put realistic numbers on it."

Because species around the world are disappearing faster than biologists can identify them, the need for a quick and accurate method of classifying life has never been more pressing, Meyer said. With millions of animal species on Earth, DNA barcoding can be a helpful identification tool for ecologists who may not necessarily be taxonomy experts, he said.

"This new technology is seen as kind of a fancy, cool tool that will revitalize museums, which will house the reference collections, and generate 'gee whiz' appreciation from the general public as well," he said.

Much of the analysis was done at the Florida Museum of Natural History at UF — where Meyer and his co-author Gustav Paulay are curators — because of its world-renowned collection of cowries. After 10 years of collecting and sequencing cowries from around the world, Meyer and Paulay assembled a database from 218 species. The public has long been fascinated by the shiny, colorful shells, ardently collecting them for centuries, Meyer said.

Ray Carson

Biologist Christopher Meyer (left) and zoologist Gustav Paulay examine cowries in the collection at UF's Florida Museum of Natural History. The two scientists are the first to quantify the effectiveness of DNA barcoding among brightly colored shells.

"The question is what happens as you move away from cowries or birds into nematodes or sea spiders and other creatures that people don't know much about," he said. "That's where the problem in identifying different species is greatest and where the bulk of the diversity of life is, including large numbers of undescribed forms."

In those cases where the data is incomplete because the collection of known species is small, scientists currently rely on threshold values to identify the likelihood of a particular specimen being a brand new species vs. being distantly related to an existing one, he said.

Using their database of these well-known animals, the accuracy of thresholds was examined supposing that their identity was unspecified. In these cases, the researchers determined that thresholds would yield a 17 percent error rate.

Besides its benefits to ecology, DNA barcoding has some forensic applications, Meyer said. One applied use already being employed is identifying the bird species responsible when a carcass damages an airplane engine, he said. "Engines are built to withstand strikes by birds up to a certain size, but not a large crane or goose," he said. "Thus, it's helpful to know which brand of shredded tweet went through the combine."

And because the technology also can identify eggs or other different life stages it could be used to help stop the spread of invasive species, Meyer said.

Immunologist Seeks Patent For Melanoma Vaccine

A vaccine against melanoma — the most deadly form of skin cancer — provides almost complete protection in mice and could lead to a similar treatment for people, according to a University of Florida immunologist who has developed a novel treatment for the cancer.

The vaccine uses inactivated or dead melanoma cells in combination with a super-antigen to boost the immune response in mice against malignant melanoma cells, said Howard Johnson, a professor of immunology at UF's Institute of Food and Agricultural Sciences. Super-antigens are proteins that are potent stimulators of immune system cells.

He said UF is in the process of obtaining patent protection for the vaccine and licensing the technology to a pharmaceutical company. Once the vaccine is licensed, human clinical trials can begin, a process that could take three or four years.

"Until now, super-antigens have never been used in a cancer vaccine, and our research shows that these proteins help provide a strong immune response against malignant melanoma," said Johnson, an internationally recognized immunologist who was the first to show that molecules called interferons are important regulators of the immune system.

"We have found that combinational therapy of super-antigens and inactivated melanoma cells can protect 60 to 100 percent of the mice against a 25-fold lethal dose of melanoma," Johnson said. "More importantly, when vaccinated mice were challenged a half-year later with a lethal melanoma dose, 80 to 100 percent survived the second challenge, which is essentially complete protection."

Johnson's vaccine would primarily benefit two groups of people: the elderly and those who have already had a melanoma lesion.

"As we age, we become more at risk for developing melanoma and other cancers," he said. "People who have had melanoma lesions successfully removed are at greater risk of developing future lesions, so vaccination should reduce the risk of recurrence," he said.

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Chuck Woods

Josh Wickham

Immunology Professor Howard Johnson collects melanoma tumor cells in his laboratory. Johnson has developed a vaccine that provides almost complete protection against melanoma skin cancer in mice, which could lead to a similar treatment for humans.

"A border guard may come across some eggs or larvae in an orange shipment and wonder if they are from a dangerous fruit fly or something else to be concerned about," he said.

For that matter, this ability to detect species in earlier stages of development could benefit ecologists in their work as well, Meyer said.

"Scientists studying butterflies are able to link caterpillars to adults in the field without having to rear them in the lab anymore to see them pupate and grow up," he said. "They can just sequence the caterpillar and link it to the adult butterfly."

Probably the most common application, for scientists and consumers alike, would be the ability to instantly analyze the DNA of a plant or animal with a hand-held device, Meyer said.

"It's very Star Treky if you can imagine McCoy having this kind of hand-held device, something like his tricorder," he said. "Is that really a cod fillet you're buying at the fishmonger?"

Although the availability of such a device might be 10 or 15 years off, it could allow scientists to have a small lab within the rain forest, collecting biodiversity data and being instantly linked via satellite to the encyclopedia of life.

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