Extracts

Opossums Point To North American Marsupial Origins

Jorge Gonzalez

Comparison of the skulls of a modern opossum and a 54-million-year-old fossil relative.

A University of Florida researcher has co-authored a study tracing the evolution of the modern opossum back to the extinction of the dinosaurs and finding evidence to support North America as the center of origin for all living marsupials.

The study, published in the online journal *PLoS ONE* in December, shows that peradectids, a family of marsupials known from fossils mostly found in North America and Eurasia, are a sister group of all living opossums. The findings are based in part on high-resolution CT scans of a 55-million-year-old skull found in freshwater limestone from the Bighorn Basin of Wyoming.

"The extinction of the dinosaurs was a pivotal moment in the evolution of mammals," said Jonathan Bloch, study co-author and associate curator of vertebrate paleontology at UF's Florida Museum of Natural History. "We're tracing the beginnings of a major group of mammals that began in North America."

Opossum-like peradectids first appeared on the continent about 65 million years ago, at the time of the Cretaceous–Paleogene extinction event, which killed the dinosaurs.

"North America is a critical area for understanding marsupial and opossum origins because of its extensive and varied fossil record," said lead author Inés Horovitz, an assistant adjunct professor at the University of California, Los Angeles. "Unfortunately, most of its species are known only from teeth."

The study also analyzes two 30-million-year-old skeletons of *Herpetotheriidae*, the sister group of all living marsupials.

Based on fossil evidence from the skull and two skeletons, the study's authors concluded the evolutionary split between the ancestor of opossums and the ancestor of all other living marsupials occurred at least 65 million years ago, Horovitz said.

Marsupials migrated between North and South America until the two continents separated after the end of the Cretaceous period. Marsupials in South America diversified and also migrated into Antarctica and Australia, which were still connected at that time, Bloch said.

North American marsupials went extinct during the early Miocene, about 20 million years ago. But after the Isthmus of Panama emerged to reconnect North and South America 3 million years ago, two marsupials made it back to North America: the Virginia opossum (*Didelphis virginiana*), a common resident in the Southeast today, and the southern opossum (*Didelphis marsupialis*), which lives as far north as Mexico.

The study describes a new peradectid species, *Mimoperadectes houdei*, based on a relatively complete fossil skull. The high-resolution CT scan of the skull gave researchers a large amount of information about the animal's internal anatomy. The ear, in particular, provides researchers with information on skull anatomy and clues about the animal's locomotion, Bloch said.

The scan showed the new species shared enough common traits with living opossums to indicate an evolutionary relationship. Some predictions about that relationship could have been made from fossil teeth, Bloch said, "but this provides a much stronger foundation for that conclusion."

Most North American marsupials living in the Paleocene and early Eocene (56 million to 48 million years ago) were small-bodied animals. But *M. houdei* approached the body size of some opossums living today.

"You would probably recognize it as an opossum, but it wouldn't look quite right," Bloch said.

The skull came from the same limestone deposits in Wyoming as the primitive primate skull Bloch and other researchers used to map an early primate brain with CT scans in a study published earlier this year.

"In parts of North America today, opossums are one of the most commonly observed mammals around," Bloch said. "This fossil skull shows its roots going back to the extinction of the dinosaurs. This is literally the fossil that shows us the ancestry of that animal."

The study's examination of the two skeletons gives a first glimpse into the form and structure of primitive marsupials and shows that they were more terrestrial than modern opossums. The skeletons came from the late Oligocene and were found in the White River Badlands of Wyoming.

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Bill Kanapaux

Sea Oats Vital To Beach Survival

It might be easy for the casual beachgoer to write off sea oats as mere weeds. However, the lanky grass holds the soil of beach dunes, making it a keystone of the natural barrier between land and water — and University of Florida researchers are using cutting-edge techniques to keep that barrier in place.

"The 2004 hurricane season showed us exactly how important it is to have effective ways of rebuilding our coastal dunes," said Mike Kane, a UF environmental horticulture professor. "Plants are an essential part of that rebuilding."

The researchers from UF's Institute of Food and Agricultural Sciences are not only developing new ways to grow the plants under laboratory and greenhouse conditions but also building a cryogenically stored library of genetically varied sea oats samples.

Four major hurricanes and a tropical storm damaged more than 800 miles of Florida shoreline in 2004, leaving 360 miles of beach critically eroded. Nearly $200 million in state and federal funding was allocated to rebuild.

Planting sea oats along reconstructed beaches isn't easy or cheap. The 22,000 sea oats plants required to populate one mile of rebuilt beach cost more than $40,000.

One of the biggest hurdles is producing enough plants that will thrive in the area being rebuilt. Many of the natural sea oats populations that serve as seed sources were damaged or destroyed during the 2004-2005 hurricane seasons, leaving researchers looking for ways to produce sea oats other than by seed.

Using a process known as micropropagation, small samples in the form of shoot buds are grown in nutrient-rich gels that contain plant-derived chemicals to spur rapid development. They are then moved to a greenhouse, where they continue to grow in preparation for their final move to the beach.

However, some variations of these delicate plants "crash" when they are moved to the greenhouse, said Sandra Wilson, a researcher at the UF/IFAS Indian River Research and Education Center in Fort Pierce.

Kane, Wilson and other UF researchers have worked for years to refine the process — fine-tuning conditions such as humidity, temperature, growth promoters and food sources.

In a recent issue of *Plant Growth Regulation*, they report that research led by former UF doctoral student Carmen Valero-Aracama showed that using the growth promoter meta-topolin can cut the number of sea oats that crash in half for some difficult-to-grow varieties.

"Sea oats are extraordinarily genetically diverse," Kane said. "This is an important finding in that it could really help improve production for almost all genotypes. Before this discovery was made, often what worked for one type of sea oat might kill another."

In fact, this diversity poses another major problem when it comes to re-establishing the plants. Beaches can have very different conditions, and it's important to try to plant the kinds of sea oats best adapted to local conditions.

Kane is using a $140,000 grant to develop methods to cryogenically freeze thousands of sea oats samples from all major populations along Florida's coasts. The collection will be used to give plant micropropagation laboratories types of sea oats native to specific areas. The funds come from Florida Sea Grant, which works to enhance practical use and conservation of coastal and marine resources to create a sustainable economy and environment.

"There is a need for millions of these plants, and this is the sort of work that is going to allow us to fill that need," said Gary Hennen, president of Oglesby Plants International, an Altha, Fla.-based business that uses micropropagation to commercially produce plants. The company hopes to be one of many that put the UF research to good use. "That's not only going to be good for our beaches, but it's potentially a major boon for a lot of businesses, as well."

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Stu Hutson

Environmental horticulture Professor Mike Kane demonstrates how to insert a plant sample into a cryogenic storage container.

Tyler Jones

Extracts

Breath Sensor Could Ease Disease Tests

A tiny sensor could provide inexpensive new diagnosis and treatment methods for people suffering from a variety of diseases.

University of Florida engineers have designed and tested versions of the sensor for applications ranging from monitoring diabetics' glucose levels via their breath to detecting possible indicators of breast cancer in saliva. They say early results are promising — particularly considering that the sensor can be mass produced inexpensively with technology already widely used for making chips in cell phones and other devices.

"This uses known manufacturing technology that is already out there," said Fan Ren, a professor of chemical engineering and one of a team of engineers collaborating on the project.

The team has published 15 peer-reviewed papers on different versions of the sensor, most recently in the January edition of *IEEE Sensors Journal*. In that paper, members report integrating the sensor in a wireless system that can detect glucose in exhaled breath, then relay the findings to health-care workers. That makes the sensor one of several non-invasive devices in development to replace the finger prick kits widely used by diabetics.

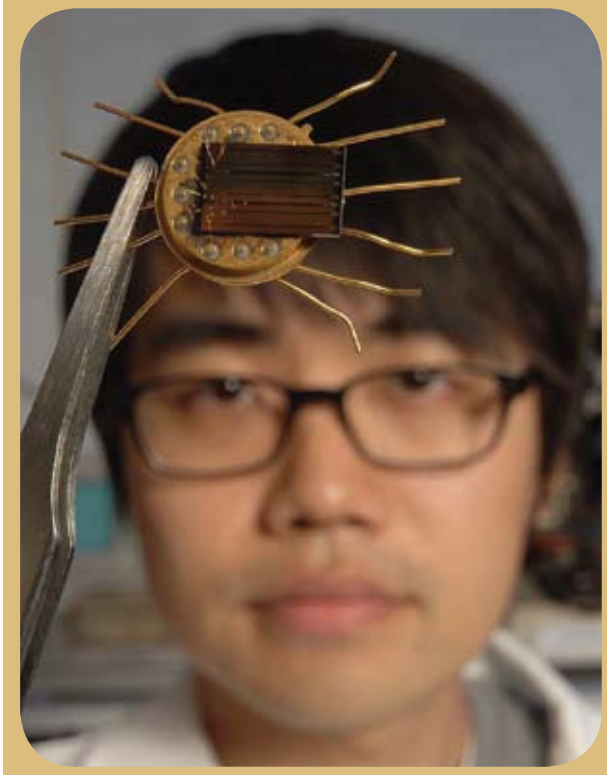
Tests with the sensor contradict long-held assumptions that glucose levels in the breath are too small for accurate assessment, Ren said. That's because the sensor uses a semiconductor that amplifies the minute signals to readable levels, he said.

"Instead of poking your finger to get the blood, you can just breathe into it and measure the glucose in the breath condensate," Ren said.

In the IEEE paper and other published work, the researchers report using the sensor to detect pH or alkalinity levels in the breath, a technique that could help people who suffer from asthma better identify and treat asthma attacks — as well as calibrate the sensitivity of the glucose sensor. The engineers have used other versions to experiment with picking up indicators of breast cancer in saliva, and pathogens in water and other substances.

As with the finger prick standard, tests for pH, breast or cancer indicators typically already exist, but they are often cumbersome, expensive or time-consuming, Ren said. For example, the current technique for measuring pH in a patient's breath requires the patient to blow into a tube for 20 minutes to collect enough condensate for a measurement.

At 100 microns, or 100 millionths of a meter, the UF sensor is so small that the moisture from one breath is enough to get a pH or glucose concentration reading — in under five seconds, Ren said.



Graduate student Byung Hwan Chu displays a new sensor that can detect glucose and chemical indicators of cancer in breath and saliva.

Ren said the sensors work by mating different reactive substances with the semiconductor gallium nitride commonly used in amplifiers in cell phones, power grid transmission equipment and other applications.

If targeting cancer, the substance is an antibody that is sensitive to certain proteins identified as indicative of cancer. If the target is glucose, the reactive molecules are composed of zinc oxide nanorods that bind with glucose enzymes.

Once the reaction happens, "the charge on the semiconductor devices changes, and we can detect that change," Ren said.

While the sensor is not as acutely sensitive as those that rely on nanotechnology, the manufacturing techniques are already widely available, Ren said. The cost is as little as 20 cents per chip, but goes up considerably when combined with applications to transmit the information wirelessly to computers or cell phones. The entire wireless-chip package might cost around $40, he said, although that cost could be cut in half with mass production.

The team has patented or is in the process of patenting several elements of the technology, and several companies have expressed interest in pursuing the research, Ren said.

"This is an important development in the field of biomedical sensors and a real breakthrough," said Michael Shur, professor of solid state electronics at Rensselaer Polytechnic Institute. "Professors Fan Ren and Steve Pearton have made pioneering contributions to materials and device studies of nitrides, and now their work has led to the development of sensors that might improve quality of life for millions of patients."

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Aaron Hoover

Lasers Ignite Nanoparticles, Offer Exciting Applications

University of Florida engineering researchers have found they can ignite certain nanoparticles using a low-power laser, a development they say opens the door to a wave of new technologies in health care, computing and automotive design.

A paper about the research appeared recently in *Nature Nanotechnology*.

Vijay Krishna, Nathanael Stevens, Ben Koopman and Brij Moudgil say they used lasers not much more intense than those found in laser pointers to light up, heat or ignite manufactured carbon molecules, known as fullerenes, whose soccer ball-like shapes had been distorted in certain ways. They said the discovery suggests a score of important new applications for these so-called "functionalized fullerenes" molecules already being developed for a broad range of industries and commercial and medical products.

"The beauty of this is that it only requires a very low-intensity laser," said Moudgil, professor of materials science and engineering and director of the university Particle Engineering Research Center, where the research was conducted.

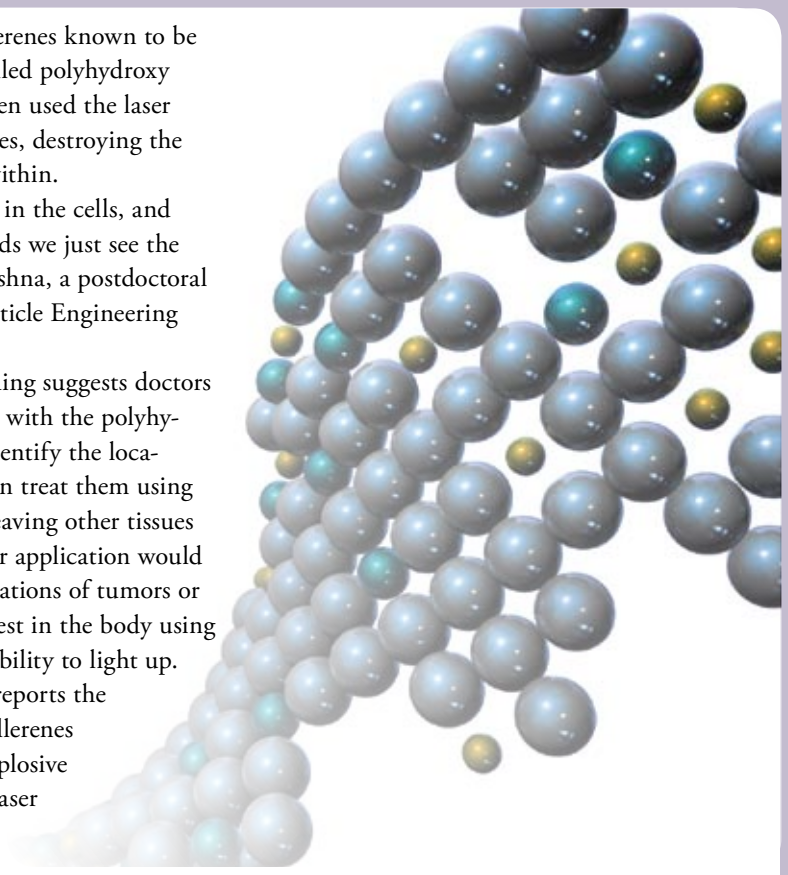
The researchers used lasers with power in the range of 500 milliwatts. Though weak by laser standards, the researchers believe the lasers have enough energy to initiate the uncoiling or unraveling of the modified or functionalized fullerenes. That process, they believe, rapidly releases the energy stored when the molecules are formed into their unusual shapes, causing light, heat or burning under different conditions.

The *Nature Nanotechnology* paper says the researchers tested the technique in three possible applications.

In the first, they infused cancer cells in a laboratory with a variety of functionalized fullerenes known to be biologically safe called polyhydroxy fullerenes. They then used the laser to heat the fullerenes, destroying the cancer cells from within.

"It caused stress in the cells, and then after 10 seconds we just see the cells pop," said Krishna, a postdoctoral associate in the Particle Engineering Research Center.

He said the finding suggests doctors could dose patients with the polyhydroxy fullerenes, identify the location of cancers, then treat them using low-power lasers, leaving other tissues unharmed. Another application would be to image the locations of tumors or other areas of interest in the body using the fullerenes' capability to light up.



Ray Carson

The paper also reports the researchers used fullerenes to ignite a small explosive charge. The weak laser contained far less energy than standard electrical explosive initiators, the researchers said, yet still ignited a type of functionalized fullerenes called carboxy fullerenes. That event in turn ignited comparatively powerful explosives used in traditional blasting caps.

Mining, tunneling or demolition crews currently run electrical lines to explosives, a time-consuming and expensive process for distant explosives. The experiment suggests crews could use blasting caps armed with the fullerenes and simply point a laser to set them off.

"Traditional bursting caps require a lot of energy to ignite. They use a hot tungsten filament," said Nathanael Stevens, a postdoctoral associate in the Particle Engineering Research Center. "So, it is interesting that we can do it with just a low-powered laser."

The researchers coated paper with polyhydroxy fullerenes, then used an ultrahigh resolution laser to write a miniature version of the letters "UF." The demonstration suggests the technique could be used for many applications that require extremely minute, precise lithography. Moudgil said the researchers had developed one promising application involving creating the intricate patterns on computer chips.

Although not discussed in the paper, other potential applications include infusing the fullerenes in gasoline, then igniting them with lasers rather than traditional sparkplugs in car engines, Moudgil said. Because the process is likely to burn more of the gasoline entering the cylinders, it could make cars more efficient and less polluting.

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Aaron Hoover

Extracts

Lone Bacteria Behind Citrus Greening

University of Florida researchers have shown that the disease that threatens to devastate the world's citrus crop is almost certainly the result of a lone species of bacteria, and not that of a combination of bacterial or viral pathogens as some have feared.

Using three types of next-generation genetic analysis, researchers from UF's Institute of Food and Agricultural Sciences examined inner bark from Florida citrus trees infected with citrus greening.

While the team conclusively found the genetic fingerprint of the bacteria commonly suspected to be behind the disease, *Candidatus Liberibacter asiaticus*, the analysis showed no other DNA of suspect viral or bacterial pathogens.

The research, published in the December issue of the journal *Molecular Plant-Microbe Interactions*, is important because the disease has been especially difficult to analyze, said Eric Triplett, chairman of UF's Department of Microbiology and Cell Sciences and lead researcher on the study.

Normally, researchers would prove that the bacteria is behind the disease by capturing a sample of the bacteria, growing it in a petri dish and then inserting it into a healthy tree to see if it causes the disease.

However, scientists have not yet found a way to get the bacteria to grow in a petri dish. This means that scientists are having trouble using their normal approaches to researching the pathogen.

This genetic analysis is just one of the innovative ways UF researchers have dealt with the irksome bacteria. For example, researchers have developed complex 3-D computer models of the bacteria in infected tree tissue, while other efforts have focused on stopping the insects that spread the pathogen.

"This research tells us that our work, much of which has been focused on Liberibacter, is dead-on, on-target," said Jacqueline Burns, director of the UF/IFAS Citrus Research and Education Center at Lake Alfred. "And it gives us confidence to move on with research that helps target this pathogen."

Along with potential treatments, the genetic analysis could help lead to new quick and inexpensive testing methods that can be early indicators of disease.

Greening slowly weakens and kills all types of citrus trees, while making their fruit malformed and discolored.

Micro-Endoscope Seeks Out Early Signs Of Cancer

Traditional endoscopes provide a peek inside patients' bodies. Now, a University of Florida engineering researcher is designing ones capable of a full inspection.

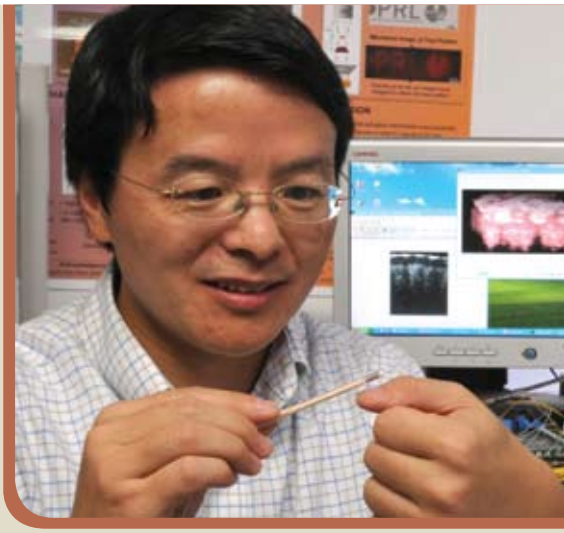
Physicians currently insert camera-equipped endoscopes into patients to hunt visible abnormalities, such as tumors, in the gastrointestinal tract and internal organs. Huikai Xie, an associate professor of electrical and computer engineering, is working on replacing the cameras with scanners that "see" beneath the surface of tissues — revealing abnormal groups of cells or growth patterns before cancerous growths are big enough to be visible.

"Right now, endoscopes just take pictures of the surface tissue. So, if you see some injury, or abnormality, on the surface, that's good," Xie said. "But most of the time, particularly with cancer, the early stages of disease are not so obvious. The technology we are developing is basically to see under the surface, under the epithelial layer."

Experiments with Xie's scanning "micro-endoscopes" on animal tissue have been promising, although his devices have yet to be tested in people. The pencil-sized or smaller endoscopes could one day allow physicians to detect tumors at earlier stages and remove tumors more precisely, increasing patients' chances of survival and improving patients' quality of life.

Xie and his graduate students have authored at least 40 papers on various aspects of the research, which is supported with more than $1 million in grants, primarily from the National Science Foundation. In September, he delivered an invited talk, "MEMS-Based 3D Optical Microendoscopy," at the 31st Annual International Conference of the IEEE Engineering in Medicine and Biology Society. He also recently launched a small company, the Gainesville-based WiOptix Inc., to speed commercialization of his scanning technology.

With current camera-equipped endoscopes, once doctors spot abnormalities,



they typically perform a biopsy, and then send the suspicious tissue to a laboratory. But biopsy is risky and may cause bleeding and even trauma. Also, it usually takes a couple of days to receive the analysis of the biopsy sample from the laboratory. If it is cancerous, surgeons may attempt to remove the abnormality and surrounding tissue, using either endoscopes equipped for surgery or traditional surgical methods.

Xie's endoscopes replace the cameras with infrared scanners smaller than

However, one of the most problematic issues with greening is that infected trees often go years before showing any of these symptoms.

This gives the disease plenty of time to spread without detection. Since there is currently no cure for greening, the only solution is to destroy infected and possibly infected trees.

So far, greening has devastated citrus crops in Asia, Africa, the Arabian Peninsula and Brazil.

In the U.S., it has been sporadically found through Louisiana, Georgia and South Carolina. The biggest presence, however, is in Florida. Since its presence was first confirmed in Florida in 2005, it has been found in 34 counties — making it a major threat to the state's $9.1 billion citrus industry.

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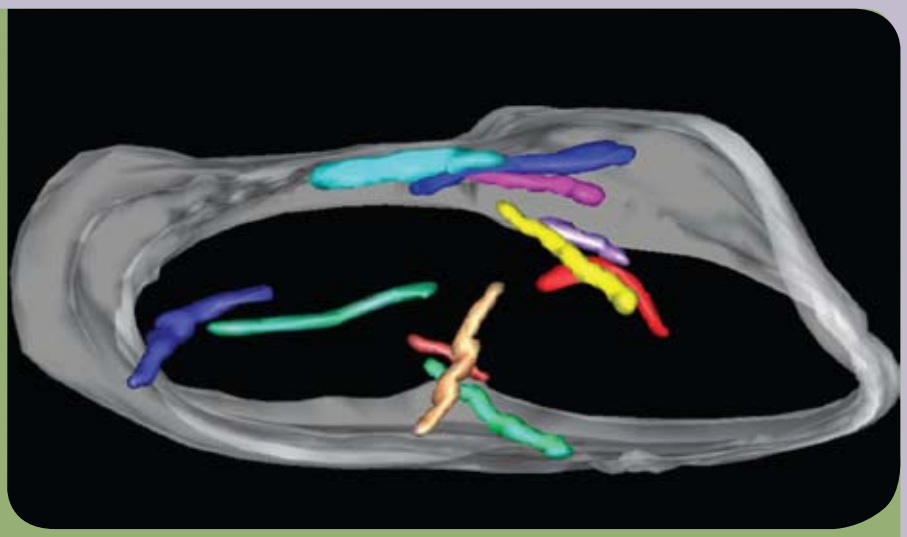

A 3-D illustration of a piece of tissue from the inner bark of an orange tree that is infected with citrus greening. The various finger-like objects are the bacteria suspected to cause the plant disease.

Ray Carson

Huikai Xie displays a micro-endoscope with a scanner that can "see" beneath the surface of internal tissues to reveal abnormal cells before cancerous growths are big enough to be spotted by traditional camera-equipped endoscopes.

pencil erasers. The heart of his scanner is a microelectromechanical system, or MEMS, device: a tiny motorized MEMS mirror that pivots back and forth to reflect a highly focused infrared beam.

By itself, the beam strikes only a period-sized dot of tissue. But the MEMS mirror allows it to move methodically back and forth, scanning a fingernail-sized piece of tissue row by row, like a lawnmower moving across a yard. The resulting image is high resolution: Xie said his scanners have achieved resolution of 10 microns, or 10 millionths of a meter, in laboratory tests. That's more than 10 times higher resolution than the only other non-camera-based endoscopes on the market, which use ultrasound technology, he said. The high-resolution image also includes depth information, so the risky biopsy can be more specific to avoid randomness, or even completely avoided.

Computers process the return signal from the endoscopes, transforming it into a three-dimensional image of the surface tissue and the tissue beneath. One scanner even produces a 360-degree image of all the tissue surrounding the endoscope. Doctors or other trained observers can then search the image for abnormalities or suspicious growth patterns.

Xie said doctors could use the endoscopes not only for diagnosis but also for treatment and surgery. Currently, he said, doctors must rely during operations on static MRI or CT images of tissue obtained before the operation begins. But his scanners make images available in real time. That would be particularly useful for regions of the body where removing as little tissue as possible is paramount, for example in brain surgery, he said.

"We are trying to couple this imaging probe with cutting tools, so that when surgeons begin cutting, they know exactly what's in front of them," he said.

David Dickensheets, a professor of electrical and computer engineering at Montana State University in Bozeman, said Xie's research shows great potential.

"The impact on quality of care could be huge, allowing more comprehensive screening than is possible with point biopsies, and making it possible to achieve both diagnosis and treatment in a single patient visit," he said in an e-mail. "Professor Xie's research is at the leading edge of this emerging technology area, and he has worked hard to move the technology out of the laboratory and into demonstration instruments that show its potential."

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Aaron Hoover

Extracts

New Technique Tracks Loggerheads' Journeys

With loggerhead sea turtle nests in dramatic decline, researchers would love to know more about where the turtles go, and what they eat, so they can better protect the creatures' habitat.

Now, a team of University of Florida biologists from the Archie Carr Center for Sea Turtle Research teasing that information from the turtles' shells reports some surprising findings.

Doctoral student Hannah Vander Zanden wrote in March in the online edition of the journal *Biology Letters* that analyses of the chemical elements in the shells of 15 living female loggerheads suggests the turtles are remarkably individualistic in their range, diet or both. The findings are unexpected because loggerheads — named for their large heads — are known to swim thousands of miles and eat 80 types of prey, often including crabs, whelks and many other ocean-bottom-dwelling creatures.

"The fact is, you have this big range of potential things they can eat, and potential places they can go, and it seems that individuals are not using that whole range," Vander Zanden said.

Although the findings need to be refined, the research could one day help scientists and public policymakers find and protect areas of the open ocean or coastal waters where loggerheads congregate or feed heavily. Such protection may be more and more urgent: On March 10, federal agencies proposed upgrading the turtle's status from "threatened" to "endangered" among seven Atlantic and Pacific populations.

Vander Zanden's findings also shed light on the turtles' habits over a span of 12 years — at least three times as long as the longest study involving satellite-tagged turtles — proving the worth of analyzing shells, or similar tissues in other animals, that contain forms of elements known as stable isotopes.

"It really revolutionizes our way of looking at these animals that have this kind of tissue."

— Karen Bjorndal
Director of UF's Archie Carr Center for Sea Turtle Research

UF doctoral student Hannah Vander Zanden painlessly gathered small shell samples from loggerhead turtles, sliced them into paper-thin wafers and analyzed them with a mass spectrometer to identify stable isotopes that provide insights into the turtles' travels and food.

"It really revolutionizes our way of looking at these animals that have this kind of tissue," said Karen Bjorndal, UF professor of biology and director of the Archie Carr Center for Sea Turtle Research, noting such animals include whales with tooth-like baleen and mammals with tusks or horns. "This loggerhead research offers the longest records that I am aware of obtained from living individuals."

James Estes of the University of California at Santa Cruz, agreed: "The length of the method — because of the isotopic analysis method — is really unprecedented."

Vander Zanden used a small biopsy punch tool to gather pencil-eraser sized shell samples from adult female turtles while they were nesting at Cape Canaveral National Seashore in Florida. Removing the samples, which cut away only the dead tissue of the shell, is harmless and painless to the turtles.

She ground the samples into thin layers and analyzed them using a mass spectrometer, a machine that separates stable isotopes according to charge and mass.

The higher an animal is on the food chain, the more heavy stable isotopes it accumulates and the greater the ratio of heavy to light isotopes in its tissue. Different ocean latitudes, meanwhile, have different ratios of light and heavy isotopes, ratios also incorporated into shells or other tissues.

So while the analyses revealed that the turtles were surprisingly different in their individual diet or travels and that they maintained these differences over the dozen years of growth reflected in the shell samples — it did not specify discrete food items or locations.

"The problem with stable isotopes is that diet and habitat are kind of confounded," Vander Zanden said. "So we can't necessarily parse out what is causing these differences — whether this turtle is eating just blue crabs or is eating whelks or whether this turtle is eating in New Jersey or in the Bahamas."

She said she will seek to sort out that question in the remainder of her dissertation research, with luck filling in major gaps about a species once celebrated as healthy but today viewed as in jeopardy. While population numbers for adult members of the species are somewhat mysterious, it is known that nests in the U.S. have declined 41 percent in the past 10 years, Bjorndal said.

"It is very important to know where they are, and what they are doing, so this work is critical," she said.

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Aaron Hoover

Dolphins Ideal Model To Study Cervical Cancer

After testing dozens of samples from marine mammals, University of Florida aquatic animal health experts say they have found the ideal model for the study of cervical cancer in people.

"We discovered that dolphins get multiple infections of papillomaviruses, which are known to be linked with cervical cancer in women," said Hendrik Nollens, a marine mammal biologist and clinical assistant professor at UF's College of Veterinary Medicine. "Dolphins are the only species besides humans that we know of that can harbor coinfections, or infections of multiple papillomavirus types, in the genital mucosa."

There are approximately 100 types of human papillomaviruses, and multiple infections of up to eight HPV types have been reported in humans, he said.

"Even more surprisingly, some virus groups have shown the ability to cross the marine-terrestrial ecosystem boundary from sea to land," Nollens said. "We have demonstrated at least one case of genetic recombination between viruses of human and marine mammals. So while it's exciting that dolphins can provide a unique window into the role of coinfection in human cervical cancer, we can't rule out that the next high-risk virus, such as SARS, or West Nile, might actually come from the marine environment."

The presence of coinfections is believed to be one of the biggest risk factors for the development of cervical cancer in humans, Nollens said, although he added that there is no evidence that dolphins develop the disease.

"Why do people develop the disease, but dolphins don't? If we can figure out why, the human medical community might be very interested in how that information might be applied to human strategies for preventing the disease," he said.

Of all creatures that inhabit the ocean, dolphins and other marine mammals are the closest relatives of humans, but researchers say scientific knowledge of infectious diseases, particularly viral diseases, affecting these animals is limited.

In hopes of shedding more light on the nature, prevalence and potential of such diseases to be passed to humans, Nollens and his colleagues at UF's Marine Animal Disease Laboratory have embarked on a large-scale collaborative research project to catalogue previously unrecognized and emerging viruses of marine mammals, both in collections and in the wild.

Dr. Hendrik Nollens and his colleagues at the UF Marine Animal Disease Laboratory have discovered more than 40 new viruses in the past few years in dolphins alone.

Over a four-year period, some 1,500 blood, tissue and fecal samples taken from dolphins have been analyzed at different laboratories across the United States, Nollens said. No animals were harmed during collection of cell and tissue samples, although some were obtained from animals that had died of natural causes in the wild.

"Some 90 percent of what we do in the laboratory is molecular analyses," Nollens said. "Because of advances in molecular medicine since January 2006, we've found more than 40 new viruses in dolphins alone. When the last textbook came out in 2003, only 19 were noted."

All viruses found in the laboratory and suspected of having pathogenic potential are further evaluated to assess the impact each could have on the health of individual dolphins, he added. The information is then used to generate guidelines for disease outbreak management and prevention strategies.

"This process helps us understand disease and disease prevention," Nollens said, adding that for more than a decade, scientists have been looking for cures to human diseases, including cancer, among marine invertebrates.

"Maybe there will be a similar story with dolphin papilloma viruses and prevention of cervical cancer in humans," he said. "It wouldn't be the first time we've come up with useful information from looking at marine animals."

The discovery of new infectious diseases and viruses in marine mammals is important for conservation as well as for a better scientific understanding of the connections between oceans and people, according to Teri Rowles, director of the National Oceanic and Atmospheric Administration's Marine Mammal Health and Stranding Response Program.

"This work highlights the importance of partnerships in this type of interdisciplinary 'One Health' science to allow us to be better stewards of healthy oceans and coasts, healthy marine mammal populations and healthy people," Rowles said.

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Sarah Carey

Extracts

Pill Signals When Swallowed, Ensuring Proper Use

Call them tattletale pills.

Seeking a way to confirm that patients have taken their medication, University of Florida engineering researchers have added a tiny microchip and digestible antenna to a standard pill capsule. The prototype is intended to pave the way for mass-produced pills that, when ingested, automatically alert doctors, loved ones or scientists working with patients in clinical drug trials.

"It is a way to monitor whether your patient is taking their medication in a timely manner," said Rizwan Bashirullah, UF assistant professor in electrical and computer engineering.

Such a pill is needed because many patients forget, refuse or bungle the job of taking their medication. This causes or exacerbates medical problems, spurs hospitalizations or expensive medical procedures and undercuts clinical trials of new drugs.

The American Heart Association calls patients' failure to follow prescription regimens "the number one problem in treating illness today." Studies have found, for example, that patients with chronic diseases normally take only about half their prescribed medications. According to the American Heart Association, 10 percent of hospital admissions result from patients not following the guidelines on their prescriptions. Other studies have found that not taking medication properly results in 218,000 deaths annually.

So-called "medication compliance" is a big problem for clinical trials, Bashirullah said, because failure to take experimental drugs skews studies' results or renders them meaningless. As a result, researchers often require visual confirmation of participants taking pills, an extremely expensive proposition if hundreds or thousands of people are participating in the trials.

"The idea is to use technology to do this in a more seamless, much less expensive way," Bashirullah said.

Bashirullah, doctoral student Hong Yu, UF materials science and engineering Professor Chris Batich and Neil Euliano of Gainesville-based Convergent Engineering designed and tested a system with two main parts.

One part is the pill, a standard white capsule coated with a label embossed with silvery lines. The lines comprise the antenna, which is printed using ink made of nontoxic, conductive silver nanoparticles. The pill also contains a tiny microchip, one about the size of a period.

When a patient takes the pill, it communicates with the second main element of the system: a small electronic device carried or worn by the patient. The device then signals a cell phone or laptop that the pill has been ingested, in turn informing doctors or family members.

Bashirullah said the pill needs no battery because the device sends it power via imperceptible bursts of extremely low-voltage electricity. The bursts energize the microchip to send signals relayed via the antenna. Eventually the patient's stomach acid breaks down the antenna – the microchip is passed through the gastrointestinal tract – but not before the pill confirms its own ingestion.

"The vision of this project has always been that you have an antenna that is biocompatible, and that essentially dissolves a little while after entering the body," Bashirullah said.

The team has successfully tested the pill system in artificial human models, as well as cadavers. Tests have determined the amount of silver retained in the body is less than what people often receive from common tap water.

The research was funded by grants totaling about $700,000 from the National Science Foundation, Convergent Engineering and the Florida High Tech Corridor Council.

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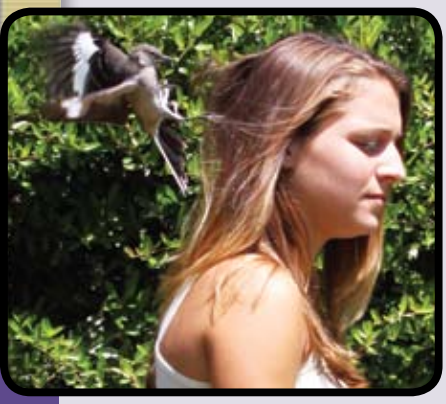
Aaron Hoover

IN THE NEWS

A HyGreen monitor above patients' beds reminds health-care providers if they need to wash their hands.

In December, NPR's *"All Things Considered"* featured UF anesthesiologist Richard Melker's invention of the HyGreen hand-washing system for hospital employees as one of its most noteworthy inventions of 2009.

"Members of Congress looking to cut health-care costs ought to listen to this next story, because if they're really looking to save money, a lot of money, they might want to start by promoting handwashing," host Guy Raz said in his introduction to the segment. "Dr. Richard Melker might just have the solution. He's developed a system that automatically tracks who's washing up."



Lou Guillette

A mockingbird attempts to drive a UF student away from its nest.

Criminology Professor Richard Hollinger was quoted in an article in *The New York Times* about the surprising source of most retail theft loss — employees.

Hollinger's research with 106 retail chains found that employees were responsible for 43 percent of unexplained losses, compared to 36 percent due to shoplifting.

"We have met the enemy, and he is us," said Hollinger, who said the most common type of employee theft occurs when cashiers do not ring up or scan goods that friends or relatives present at the register.

Research by UF biology Professor Doug Levey showing that mockingbirds recognize, remember and act violently toward people who they percieve as threatening to their nests was listed as one of the top 100 science stories of 2009 by *Discover* magazine.

"Mockingbirds Know Who You Are... And They Hold a Grudge," read the *Discover* article. "The birds learned to identify an aggressive researcher and ignore the others — and eventually they dive-bombed the malefactor."

USA Today turned to geophysics Professor Raymond Russo to explain the mechanics of the catastrophic earthquake that hit Haiti in January.

Russo explained that the quake occurred when two portions of the Earth's crust along the Enriquillo fault between the Caribbean and North American tectonic plates slid past each other.

"The fault is shallow," Russo said. "It's near the surface, so the shaking is severe and the rolling surface waves really do damage."

Associate Professor Heather Hausenblas of the Department of Applied Physiology and Kinesiology was quoted in *Parade* magazine about her findings that people who exercise feel better about their body image even if they are not really becoming fitter.

"The duration and intensity of the exercise didn't seem to matter," Hausenblas said. "People felt better about their looks even if they didn't lose fat or gain muscle. One of the reasons may be that exercise lowers levels of anxiety and depression, and that manifests in body image."