

Spotlight on Science at the Smithsonian

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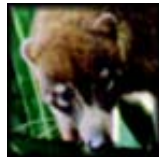
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Smithsonian Under Secretary for Science



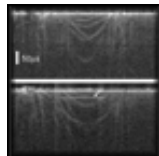
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Spotlight on Science at the Smithsonian

Spotlight on Science at the Smithsonian is a bi-weekly electronic newsletter about Science at the Smithsonian. It is produced for the Smithsonian community by the Office of the Under Secretary for Science. To subscribe to the newsletter or Podcast, visit science.si.edu.

- Dr. David Evans, Under Secretary for Science
- Theresa Mellendick, Editor, mellendickt@si.edu



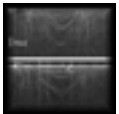
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Commentary from the Under Secretary for Science



This edition of Spotlight on Science at the Smithsonian gives us a chance to focus for a moment on just one example of the Smithsonian's wide-ranging scientific explorations and the practical applications of our expertise to real world problems; in this case, Avian Flu and West Nile Virus.

The Smithsonian biological science units study a vast collection of living and preserved animals. Scientists gather data on both living and extinct wild animal populations, in remote and urban settings around the world, and provide public exhibition programs at the National Zoo and the National Museum of Natural History.

This vast and seemingly esoteric collection of human and scientific resources, it turns out, has some very practical services to offer the global community, at a time when diseases spread around the world first, at the plodding pace of a duck's waddle, and later at that speed of a jet airplane.

As the looming menace of avian flu wings its way across Eurasia, the expertise and resources of Smithsonian scientists are being marshaled to help monitor and mitigate the threat of this and other epizootic diseases—those transmitted between animals and humans.

Our national and international network of collaborators, knitted together through decades of Smithsonian-based programs, such as training tropical biologists from developing nations at our Conservation and Research Center in Virginia is indispensable when facing these challenges. Thanks to these programs, foreign scientists trained at the Smithsonian can be found heading wildlife reserves and institutions around the

world. This creates a cooperative atmosphere and fosters communication that could be achieved in no other way.

So we find ourselves uniquely positioned to help track and respond to the identification and spread of avian disease. The Smithsonian currently houses a cadre of specialists in all aspects of bird biology, specialized laboratory and analytic capacities, and holds existing partnerships with key federal agencies and national and international networks.

While we are currently gearing up to assist in the assault on Avian Flu, it is instructive to look back on our efforts to fight avian malaria, and review our surveillance programs in West Nile Virus.

We were, for example, the first to track the spread of West Nile Virus south into Latin America.

The Smithsonian Migratory Bird Center has widely recognized expertise in studying the conservation of birds in managed and fragmented landscapes, and the effect of habitat and climate change on bird populations. They focus on the patterns of migration and migration ecology. That knowledge is directly relevant to predicting and tracking the potential spread of avian flu in migratory birds.

The Smithsonian has active long-term monitoring programs for birds, including sampling for diseases at its own facilities, as well as at collaborating with others. The Smithsonian Tropical Research Institute in Panama sits in the migration pathway of some 150 bird species. We also manage the "Neighborhood Nestwatch" citizen-science program, and collaborate with other citizen-science programs, such as that run by Cornell University. Using the public as observers, these programs provide data on both current status, and past occurrence, of bird diseases over entire continents.

Neighborhood Nestwatch

http://nationalzoo.si.edu/ConservationAndScience/MigratoryBirds/Research/Neighborhood_Nestwatch/



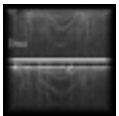
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Introduction from the Under Secretary for Science

The National Zoo's population of captive birds at Rock Creek and Front Royal are intensively monitored for diseases, and provide a sentinel population for disease monitoring with links to excellent veterinary, pathology and diagnostic staff and facilities.

The Smithsonian's bird specimen collections at the National Museum of Natural History are another critical resource. When scientists recently reconstructed the 1918 pandemic flu virus and needed to understand the viruses that existed in bird populations in 1917

through 1919, they turned to our museum holdings to extract viruses from preserved tissue samples.

It is this combination of cutting-edge scientific knowledge, continually developing expertise, a world-wide network of scientific collaborators, practical, on-the-ground and in-the-field experience and a historic collection of specimens that positions the Smithsonian to play a vital role helping to safeguard both human and animal populations from the continued threat of evolving diseases.



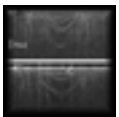
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The common myna, *Acridotheres tristis*.

Deciphering the Distribution of Infectious Diseases

Reference

Farah Ishtiaq, et al.,
Prevalence and evolutionary
relationships of haematozoan
parasites in native versus
introduced populations of
common myna *Acridotheres
tristis*. *Royal Society B* (online).

The success of introduced species is frequently explained by their escape from natural enemies in the introduced region. Now, this phenomenon—the enemy release hypothesis—is being looked at in connection with the spread of avian flu and other emerging infectious diseases. Learning the distribution of such invasives is important to combat their threat and learning the mechanisms for distribution is key to prevention and control.

Program Head Robert Fleischer, postdoc Farah Ishtiaq and graduate student Jon Beadell of the Smithsonian Institution Genetics Program recently completed a study of parasites in mynas. The study entitled "Prevalence and evolutionary relationships of haematozoan parasites in native versus introduced populations of common myna *Acridotheres tristis*" in *Proceedings of the Royal Society B* (online) assesses the distribution of malarial parasites using two well-known blood parasite genera (*Plasmodium* and *Haemoproteus*) in native and six introduced populations of the common myna *Acridotheres tristis*.

This is the first comparative study conducted on blood parasites in birds that have been introduced in multiple locations from a native region and tests the enemy

release hypothesis which would predict that a species that relocates leaves behind an "enemy" (parasites) and is therefore able to thrive in the new region without the parasites. Conclusions show that not all comparisons of introduced populations to the native population were consistent with the enemy release hypothesis.

Although there is some evidence that common mynas may have carried parasite lineages from native to introduced locations, and also that introduced populations may have become infected with novel parasite lineages, it may be difficult to differentiate between parasites that are native and introduced, because malarial parasite lineages often do not show regional or host specificity. For example, populations in Australia and South Africa had equivalent parasite loads to those found in India. In addition, evidence suggests that while mynas brought parasites with them from India to their new homes in such places as Australia, South Africa and New Zealand, they also picked up new parasite types when they arrived. These findings are particularly relevant as they might apply to the spread of avian flu and other emerging infectious diseases.



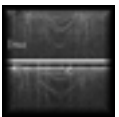
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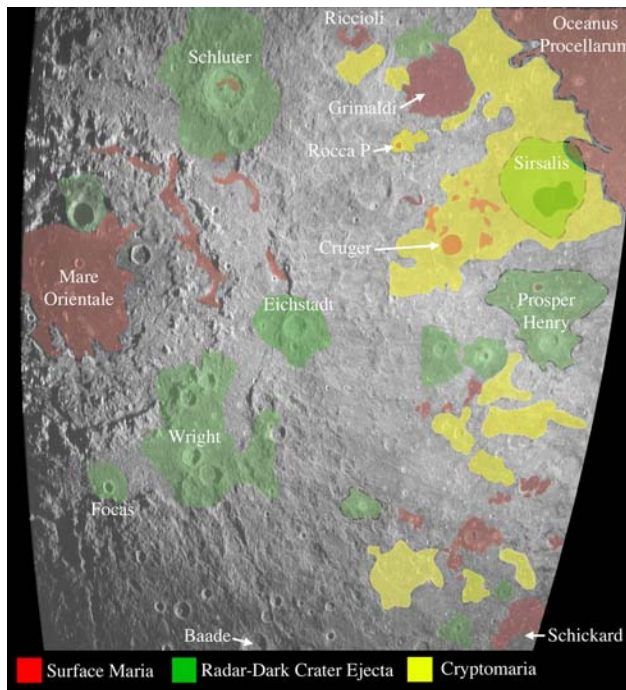
Looking Deep Into the Moon's Past



"Prey Rolling" Behavior of Coatis



Exploring the Subsurface of Mars



A radar map of the southwest portion of the Moon.

Looking Deep Into the Moon's Past

Our Moon is a quiet place today, with no wind and water to modify the landscape, but billions of years ago the surface was being changed by outpourings of lava that flooded the basins carved by gigantic impacts. The last of these basins were formed after the great volcanic eruptions began, so in some regions the record of ancient volcanism is hidden beneath deep layers of impact-generated debris. Older basalt deposits obscured by later material are called "cryptomaria".

A new way to search for ancient volcanic materials is provided by Earth-based radar images that use long radio wavelengths to penetrate deep into the mixed rock and dust layer that covers the Moon. A group led by the National Air and Space Museum's Bruce Campbell and including colleagues at the Smithsonian Astrophysical Observatory has collected a nearly complete radar map of the Earth-facing side of the Moon with a spatial resolution of about 500 m. The radar signals are transmitted from the

Arecibo Observatory in Puerto Rico, and echoes from the Moon are received at the Greenbank Telescope in West Virginia. Using a radar wavelength of 70 cm, depths up to 50 m in the lunar highlands can be probed.

The new radar data reveal an area of about 180,000 km² on the west side of the Moon that represents ancient basaltic material now covered by debris from the formation of Mare Orientale (perhaps the youngest large basin on the Moon). The cryptomare area has a lower radar echo than the nearby highlands because basalts contain iron and titanium minerals that absorb more of the radio signal. These lava flows may extend even farther west, but the depth of the Orientale ejecta eventually becomes too deep to discern the buried basalt. Ongoing work studies more localized deposits of ancient basalt across the Moon, and the role of the giant basins in forming the lunar highlands surface.



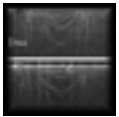
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Coatis use "prey-rolling" to defeat certain prey's defenses. Photo by Carl Hansen, Smithsonian Institution.

"Prey-Rolling" Behavior of Coatis

Many animals adopt special prey handling methods when they encounter difficult prey organisms. For example, some birds use special methods when preying upon hard-shelled invertebrates such as snails and some arthropods. The birds may smash the prey with rocks or drop them onto hard substrates. Many mammals that prey upon arthropods that possess irritating hairs or noxious secretions roll them on the ground to neutralize offending features ("prey-rolling").

Coatis (*Nasua* spp.), which are relatives of raccoons, are well known to prepare noxious invertebrates by prey-rolling. This behavior has been observed in the field with a variety of prey items, including millipedes. Coatis have often been observed preying millipedes, and their feces often contain millipede remains. In addition, coatis are well known to depend upon their sense of smell as a means of identifying prey. They typically forage by shuffling their noses through leaf litter and soil. This behavior prompted a study of the responses coatis show to benzoquinones, which are defense compounds produced by many millipedes. Most millipedes in the tropics secrete these compounds through numerous glands on their body segments. When

coatis attack millipedes, they roll them on the ground, thereby neutralizing the negative effects of the benzoquinones.

A recent study published by National Zoo scientist Paul Weldon suggests that the chemicals produced by millipedes as a defense mechanism may actually provide predators a way to locate them. Many other insects produce and discharge benzoquinones for defense. This evolutionary "defense" mechanism may, in fact, have the opposite effect; attracting predators and providing an ideal means for locating the chemically "defended" prey. These chemical defenses are then easily defeated through prey-rolling behavior.

This study represents the first identification of chemicals that may actually elicit predatory behavior in a mammal. Studies like these help demonstrate that evolution is an ongoing and complex intermeshing of biochemical and behavioral relationships between competing species. In this case, a predated animal develops a chemical response to attack, and one class of predators learns not only to foil the defense, but how to use it to its advantage.



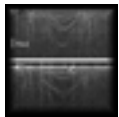
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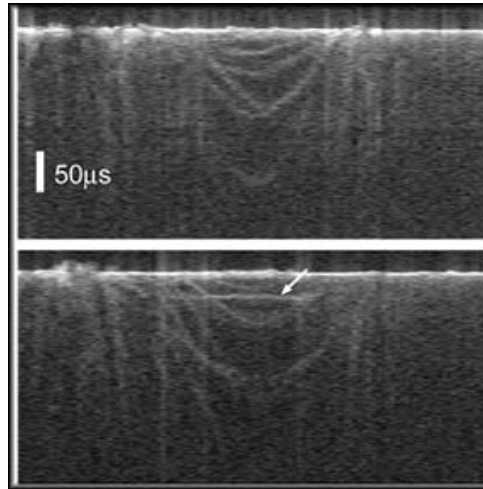
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MARSIS data for adjacent orbits 1892 (top) and 1903 (bottom) over an area in Chryse Planitia in the northern lowlands of Mars. The sounding data show multiple parabolic-shaped echoes and a linear echo in orbit 1903 (arrow). The vertical axis is time-delay in microseconds.

Exploring the Subsurface of Mars

Reference

Giovanni Picardi, et al., Radar Soundings of the Subsurface of Mars. *Science*. 23 December 2005 310: 1925-1928

The first subsurface sounding data for the shallow crust of Mars has been returned by the Mars Advanced Radar for Subsurface and Ionospheric Sounding (MARSIS) scientific package flying on the Mars Express spacecraft. After the successful deployment of MARSIS in June 2005, data were collected over the Martian north polar cap and northern lowlands. The initial data indicate that radar signals penetrated approximately 1.8 km of ice exposing the base of the north polar layered deposits. The observations suggest that the north polar layered deposits are composed of nearly pure to slightly dirty water ice. MARSIS data over the northern lowlands have revealed a series of axially symmetric parabolic-shaped echoes in two adjacent orbits. The echoes suggest a circular structure that may be a buried impact basin. Such subsurface impact basins

have been inferred through observations of subtle topographic depressions visible on the planet's surface. The MARSIS data confirm this inference while also indicating that there is a population of basins without expression in the topography. In addition to the parabolic echoes, a prominent linear echo suggests an interface up to 2.5 km below the surface. The depth of the interface is consistent with the expected depth of the floor of a 200 to 300 km diameter impact basin. The echo power of the linear reflector suggests a large volume of low-loss material fills the basin. One possibility is that the basin fill is comprised of an ice-rich material. An international team of scientists that includes Smithsonian National Air and Space Museum planetary geologist, Thomas R. Watters, reported in the journal *Science* in December, 2005.



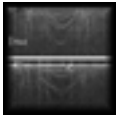
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