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Spotlight on Science at the Smithsonian

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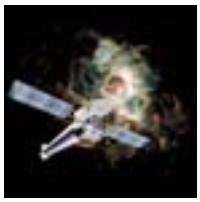
- Introduction from Dr. David Evans, Smithsonian Under Secretary for Science



- Astronomers Find Fewer White Dwarves Than Expected

- Natural Selection Favors Diversity in Tropical Forests

- Attempting to Preserve a Specimen After Death, and a Species After Extinction

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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.

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

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Introduction from the Under Secretary for Science

In this edition of Spotlight on Science, we'll see how scientific exploration, more often than not, yields the unexpected. Smithsonian Astrophysical Observatory scientists, scouring 6 years of detailed X-ray data of the Milky Way, discovered what is not there. Data from the Smithsonian Center for Tropical Forest Science reveals that rare tropical trees may benefit from being rare. And Natural History and National Zoo researchers join to preserve a bird specimen in a way that keeps open the possibility for future cloning of an extinct species.

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An artist's depiction of the Chandra X-Ray Observatory in space, with a Chandra image of a hot nebula in the background.

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Reference
J. Grindlay et al., "Chandra Multiwavelength Plane (ChaMPlane) Survey: An Introduction." *Astrophysical Journal Letters*, 2005, 635, L920.

First, we're off to Cambridge Massachusetts, home of The Smithsonian Astrophysical Observatory's Chandra team. This group of scientists is scouring X-ray data from the dense sea of stars that make up our Milky Way galaxy. They're focused on locating, identifying and studying exotic objects such as black holes, neutron stars, and white dwarves that stretch our understanding of physics. These so-called compact bodies are the remains of the tremendous explosions of very large stars. Of course, in stellar terms, "compact" is a relative concept. A neutron star is a sphere only about 10 kilometers in diameter, yet it packs in the matter of an entire Sun. While gravity holds us to the Earths surface quite comfortably, the gravity of a neutron star would squash you flat. Then there are the more mundane "white dwarves." Rather than packing all that mass into a 10 km sphere, a white dwarf is the size of the Earth. When an even larger star explodes, the collapsed remains can form a much more mysterious object; a black hole. The gravity is so strong around this object that rather than producing light, it sucks it in.

All three of these compact objects are believed to be faint emitters of x-ray radiation. The Chandra X-ray Observatory is a telescope orbiting the Earth, tirelessly detecting these minute emissions, and slowly forming a more complete view of our galaxy.

The team has published the first in a series of findings in the *Astrophysical Journal Letters*. The authors identified 7,045 X-ray sources in a combined region of the sky as large as the area that would be blocked out by about ten full-moons placed end-on-end. The scientists have conducted further observations of many of these X-ray sources in a series of detailed optical observations, searching for visible light. It turns out that only half of these x-ray emitting objects actually emit light we can see with our eyes with the aid of telescopes. The others gave off no visible light at all. The finding suggests that our previous estimate of the number of white dwarves is about three times too large.

It is through this constant testing of hypothesis and refinement of tools and techniques that science is able to pick its way down a path toward greater understanding of our universe, allowing us to appreciate the intellectual achievements of the past while securing new understanding for the future.

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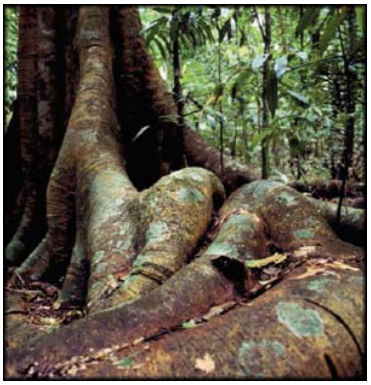
Being unique can lead to success in the tropics.

Natural Selection Favors Diversity in Tropical Forests

From frigid Massachusetts, we now travel to more tropical climes to take a closer look at some botanical research. Being the odd duck, congregating with groups that share few of your characteristics, and, of course, laying down solid roots, may be a recipe for longevity; especially if you're a tropical tree. A researcher studying the distribution of tree species in pristine tropical forests around the globe has dug up evidence that locally rare tree species tend to live longer and out compete their more common neighbors. This finding, and its potential underlying mechanisms, suggests that diversity may be favored by evolutionary processes. In other words; being different is adaptive.

Smithsonian Tropical Research Institute scientists and colleagues from around the world studied decades of data on seven tropical forests. The data came from India, Puerto Rico, Panama, Thailand, Sri Lanka, and Malaysia, and was collected by a consortium of host country institutions coordinated by the Center for Tropical Forest Science (CTFS), based at the Smithsonian Tropical Research Institute in Panama. Researchers sampled the forests at five or ten year intervals, counting every tree over 1 cm. in diameter at chest height. They also noted dead trees and tracked the number of trees that had grown big enough to be counted since the previous census. Because of the central coordination by the Smithsonian, the same protocols were used at each location and the data can be compared accurately.

The scientists found that regardless of the forest, or the size of the plot sampled, more trees of the locally common species died over time than did members of the rarer species, increasing the relative representation of rare species. In an article featuring this study, in the January 27th, 2006 issue of *Science* magazine, ecologist Theodore Fleming of the University of Miami, Florida noted that around the globe, "One would not expect to find such congruence unless similar processes are operating."

This success of the rare species is being attributed to the possibility that, with fewer relatives around, there is lower competition for the specific resources like light and nutrients on which that species thrives. This isolation also lessens the possibilities for the less abundant trees to share potentially fatal diseases.

This new finding is at odds with the "neutral theory" of forest diversity which holds that plant species are gained and lost randomly. The new result suggests a mechanism that drives an ecosystem toward increased diversity.

If this process can be seen to repeat with other plant and animal species in other ecosystems, it could represent a more universal feature of evolution, providing further evidence that increasing diversity is an adaptive and self-perpetuating feature of life.

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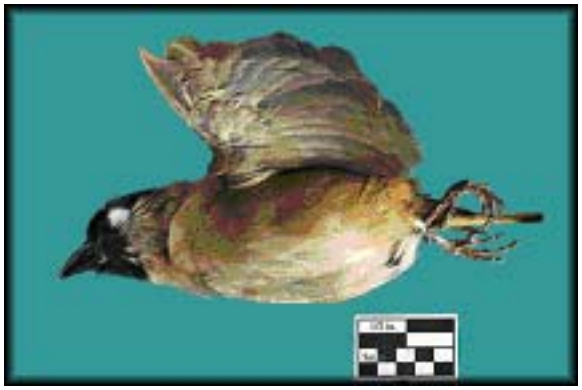
Photo of a Hawaian Po'ouli.

Attempting to Preserve a Specimen After Death, and a Species After Extinction

Finally we turn to animal sciences and the demise of the last known Hawaian Po'ouli bird. Its death, in November 2004, brought to an end yet another of Hawaii's fascinating and fragile avian species. Whenever an animal dies in a controlled environment, such as a zoo or other propagation facility, it is vitally important to determine exactly what caused the death. With animals relying on human caretakers for their complete diet, shelter and husbandry, and being in close contact with other animals, it is imperative that pathologists ensure that the death was not caused by an agent that could affect other creatures in the facility.

At the same time, even in death, a representative of a rare species can serve the cause of furthering knowledge of its group by yielding clues to its biology as a preserved specimen. And with modern technologies, perhaps the animal's cells can even serve as precursors to a cloned line of descendants sometime in the not too distant future.

The tension between the need to examine the body while preserving it for further study was explored by Helen James, of the National Museum of Natural History, and Tabitha Viner, head pathologist at the National Zoo. Together James and Viner worked on the Po'ouli's necropsy; an autopsy for non-humans. Tissues and cell cultures were taken for future genetic studies and even possible cloning of this now extinct species.

The necropsy was done with utmost care for the cosmetic preservation of the carcass. The remains were transformed into a study skin with attached spread wings and loose feathers, a formalin fixed/alcohol preserved carcass, and tissue samples. The bird was carefully photographed and copious notes were taken.

This specimen, one of only three in the world, is currently at the Bernice P. Bishop Museum in Honolulu, HI.

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