Smithsonian

# Spotlight on Science at the Smithsonian

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**Spotlight on Science at the Smithsonian**

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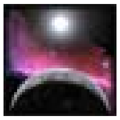



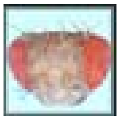



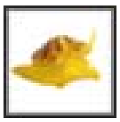



# Introduction from the Under Secretary for Science

In this installment of Spotlight on Science we first consider the search for intelligent life in other galaxies. It’s been fruitless so far, but two astronomers suggest that a new generation of radio telescopes may have better luck eavesdropping on distant civilizations. Intelligence here on Earth is the subject of the next story. The evolution of intelligence is surely a good thing, but big brains are costly metabolic investments. A biologist at STRI argues that evolution may sometimes favor smaller brains. And finally, Smithsonian scientists discover a new world right here on Earth in a little-visited corner of the Pacific Ocean. Off the coast of Panama, nearly half of its species are unknown to science.

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Artists rendering of a hypothetical distant world inhabited by intelligent aliens. The Mileura Wide-Field Array will be able to “eavesdrop” on signals from such worlds within 30 light-years of Earth.

# Lending an Ear to the Search for E.T.

**Smithsonian Researchers**

Abraham Loeb and Matias Zaldarriaga (Harvard-Smithsonian Center for Astrophysics)

**Reference**

A. Loeb and M. Zaldarriaga. Eavesdropping on Radio Broadcasts from Galactic Civilizations with Upcoming Observations for Redshifted 21cm Radiation. *Journal of Cosmology and Astroparticle Physics*. 2007, In Press.

### *Findings*

Researchers hunting for intelligent extraterrestrial life may soon have unprecedented opportunities to eavesdrop on alien radio broadcasts. Radio telescope facilities currently in development will have the capacity to survey thousands of star systems for possible radio signals from Earth-like civilizations.

### *Why It Matters*

Probably no field of astronomy captures the imagination more than the Search for Extraterrestrial Life (SETI). But no other faces more uncertain odds for success. Is anyone even out there? For this reason, ambitious SETI projects have often had trouble finding funding, and most work has “piggybacked” on more conventional astronomical research programs. Until now, research facilities have had only limited capacity to survey space at the radio frequencies most likely to be emitted by advanced civilizations: 50 to 400 megahertz. This is the frequency range used by most earth-based broadcasters, mainly military radar and FM radio, it has traditionally been avoided by radio astronomers because of interference problems. But an important new frontier in radio astronomy is mapping the faint radio glow of hydrogen atoms in the distant young universe, which requires frequencies that overlap the broadcast band.

### *Methods*

The Wide Field Array currently under construction in Australia will include instruments such as the Low Frequency Demonstrator with a sensitivity in the 80-300 megahertz range. Loeb and Zaldarriaga calculate that a month-long survey of the sky with the Low Frequency Demonstrator could pick up radio signals from Earth-like civilizations on planets circling the 1,000 nearest stars up to 30 light years away. Other projects in development, such as the Square Kilometer Array, will be able to probe 10 times farther, listening in on signals from 100 million stars.

### *What’s Next*

If alien radio signals are detected, they could give clues about their home planet, even the signals themselves could not be interpreted. Characteristics of the signal and how they varied over time could give information on the planet’s rotation and its orbit around the host star. Combined with information about the star, this could allow astronomers to estimate the planet’s mass, its temperature, and even its likelihood of harboring liquid water.

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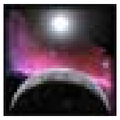

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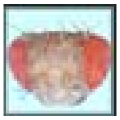
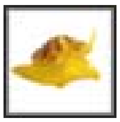
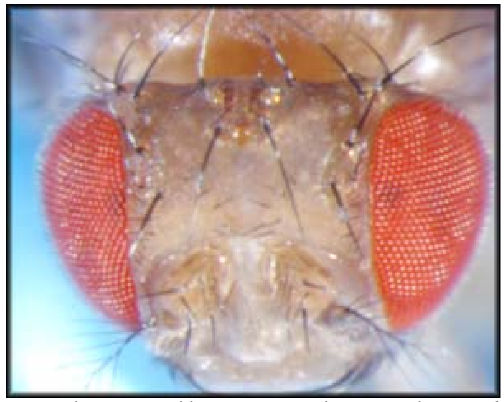


Brain Evolution: Is small sometimes beautiful?



A Trove of New Species in the Eastern Pacific



Researchers were able to measure the energetic cost of information processing in the neurons of fruit flies, such as this *Drosophila* species.

# Brain Evolution: Is small sometimes beautiful?

### *Findings*

Brain evolution involves a trade-off between better information processing and the high metabolic cost of brain tissue. Sometimes this can lead to smaller rather than larger brains—perhaps even in primates.

### *Why It Matters*

The discovery of a diminutive fossil hominid on the Indonesian island of Flores made headlines around the world. Some critics have doubted that the find represents a new species, however. The brains were too small. While it is not unusual for animal populations on islands to become dwarfed, in this case the reduction of the brain size seemed too extreme to be explained by evolution. Instead, argued the critics, it was pathology—microcephalia. But how small is too small? The Smithsonian's Jeremy Niven argues that this is still an open question. The brains of the "fossil hobbits" may be small by human standards, but they are still relatively large compared to those of other primates. There have been other examples of evolutionary brain reduction in mammals such as goats and bats. Most intriguing, however, are Niven's experiments on the metabolic cost of neural activity in insect brains. He has found that the metabolic cost of keeping brain cells alive and functioning increases steeply with performance. In a situation where food was scarce and energy needed to be conserved, "extra" brains might be a disadvantage, especially in a predator-free environment such as a small island where less complex behavior was necessary. Natural selection would then lead to smaller brains, such as those seen in the Indonesian hominids.

### *Methods*

Niven's uses microelectrodes inserted into individual neurons to record neural firing and other electrophysiological and comparative techniques to investigate the underlying principles governing the evolution of neural circuits.

### *What's Next*

Niven's experiments are the first ever to obtain a quantitative measure of the energetic cost of neural activity versus rate information processing. Further work on other types of neural tissue and tissue from other species should help clarify how neural circuits evolve and the trade-offs between neurologic performance and metabolic cost.

**Smithsonian Researchers**

Jeremy E. Niven (Smithsonian Tropical Research Institute)

**References**

Jeremy E. Niven. Brains, islands and evolution: breaking all the rules. *Trends in Ecology and Evolution* (**22**). December 2006.

Jeremy E. Niven, John C. Anderson, Simon B. Laughlin. Fly photoreceptors demonstrate energy-information trade-offs in neural coding. *PLoS Biology*. 2007. In Press.

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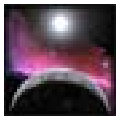

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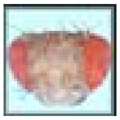

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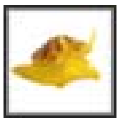

A Trove of New Species in the Eastern Pacific

This marine snail, *Tylodina fungina*, was collected in a dredge sample with its host sponge. This species feeds exclusively on a single species of sponge that matches its yellow color exactly. Despite being featured in field guides, very little is known about its biology. Photo credit: Antonio Baeza, Smithsonian Tropical Research Institute

# A Trove of New Species in the Eastern Pacific

**Smithsonian Researchers**

Rachel Collin (Smithsonian Tropical Research Institute), Jon Norenburg (National Museum of Natural History), Hector Guzman (Smithsonian Tropical Research Institute)

### *Findings*

Smithsonian scientists have discovered a biodiversity bounty in a unique, understudied region off the coast of Panama. Approximately 50 percent of the organisms found in some groups are new to science.

### *Why It Matters*

Although they expected to find new species, the team was surprised by the sheer number of novel marine organisms in the region. One group, known as ribbon worms, range in size from those so tiny they live between grains of sand to 6-foot-long specimens that eat entire crabs and sea hares. More than 50 percent of the ribbon worm species collected have never been seen before. One new species of ribbon worm discovered during the expedition live and reproduce among crab eggs. These worms can be important pests of commercial species, but they are often overlooked because they are smaller than the eggs themselves. Even soft corals, a relatively well-studied group, yielded 15 new species in a complimentary project.

One of the unique features of the islands off the coast of Panama is that they host animals that normally are found in the Indo-Pacific, half a world away. This implies that the larvae of species such as *Hymenocera picta*, a little shrimp collected on Isla Seca off the coast of Panama, can survive a journey of more than 3,000 miles from the Indo-Pacific.

The scientists hope their data will be useful for ANAM (Panama's environmental agency) and to STRI's Juan Mate, who leads the effort to develop an innovative management plan for Coiba National Park, a UNESCO World Heritage site.

### *Methods*

Coordinated by Rachel Collin of the Smithsonian Tropical Research Institute, a team of Smithsonian scientists and international collaborators with expertise in snails, crabs, shrimp, worms, jellies and sea cucumbers participated in an intensive effort over 11 days in the region to discover organisms from this ecosystem.

### *What's Next*

What species live here? How much of this biota remains unknown to science? What are the relationships to other world regions? The results of this collection trip will be published in the scientific literature during the next several years, as taxonomists classify each organism.

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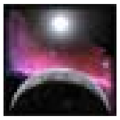

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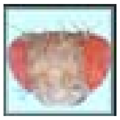

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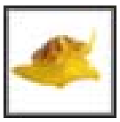

A Trove of New Species in the Eastern Pacific



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