



<b>Title</b>	<b>Population structure in a Philippines hot spring microbial mat</b>
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4. Microbial content: almost 3000 images and descriptions of taxa are available for use by educators and students.
5. Other educational resources: the site contains additional resources to assist teachers. These include talks, copies of general illustrations, animations and Lucid matrix identification guides.

Micro\*scope is designed to be a distributed and collaborative web site and contributions by microbiologists and interested educators are welcomed.

### Auditing the Earth

Stuart L. Pimm • *Center for Environmental Research and Conservation; Columbia University*

There was once a time when thoughtful people considered our oceans to be unbounded, the fish stocks within them inexhaustible, the prairies to be a vast wilderness, and the forests to be unending and impenetrable. Is this true today? I will audit the land, the oceans, and the variety of life found there and present seven key numbers.

1. There are six billion of us. That number is rising and (optimistically) will increase by 50% by mid-century.
2. We use about two-fifths of the land's plant production every year. Most of the stuff we use is from the warmer, wetter half of the planet where plants grow best. What remains is much less suitable. The warm wet places are where forests can grow and the warmest and wettest are the tropical rain forests.
3. Our use of these forests is not sustainable. The world's tropical forests are shrinking by 10% of their original area per decade.
4. The drier half of the land surface offers less plant production; it is harder to grow crops there. Dry lands are harder to use, provide less food, and are easier to abuse. On over half their area, wind and water erosion has depleted the fertility of the soils. Grazing animals have changed the vegetation in ways that make it less suitable to them.
5. Water is another universal currency. Of the rain that falls over land, the land soaks up two-thirds. We use nearly the same proportion of that (two-fifths) as the plant growth it makes possible. The remaining third runs off the land into rivers, mostly in remote places or as floodwater. We consume 60% of the accessible runoff each year.
6. About 90% of the ocean is a biological desert. We use a third of the ocean's production in the remaining 10%. The fraction is not increasing. On the contrary, overwhelming evidence shows that we are destroying the ocean's ability to supply even what we take now.
7. Summarizing human impacts in relation to so much "stuff" leads to succinctness, yet it misses significant details. Life's variety matters. There are probably 10 million kinds of animals and plants, and no more than one in a million – ten – would go extinct per year naturally. In recent history, we have been liquidating species at the rate of 1 in 10000 per year. That's 100 times faster than the natural rate. The rate is now accelerating to between 1000 and 10000 times the natural rate. Nearly a third of all species could be on a path to extinction by the middle of the century.

Humanity's future will be massively different from the past, even if we continue on our present course. We should be informed about present and our likely future for we cannot evaluate our options if we are not.

### Population structure in a Philippines hot spring microbial mat

Stephen Pointing • *The University of Hong Kong, Sanjay Nagarkar • The University of Hong Kong, Gavin Smith • The University of Hong Kong, Kimberly Warren-Rhodes • NASA Ames Research Center*  
Surface-dwelling microbial mats within discreet pools of 44.8, 53.3 and 60.1 °C were sampled using a nested design, in order to gather information on within and between spring variation in population diversity. Denaturing gradient gel electrophoresis (DGGE) will be used to distinguish between PCR amplicons from mat samples obtained using cyanobacteria- and eubacteria-specific primers. Assignment of DGGE bands to individual species will be attempted by sequence analysis.

These data will be compared with estimates of diversity using direct observation of cell morphology within mats and isolation of axenic cultures from enrichment. This presentation illustrates sampling locations and rationale, plus preliminary data from molecular and microscopy studies. Initial findings suggest a unique photosynthetic population structure within these mats, but little within and between pool variation.

### A research informed approach to developing an engaging classroom ready curriculum for teaching astrobiology

Edward Prather • *University of Arizona, Timothy Slater • University of Arizona*

Effective inquiry-based instruction requires that teachers possess a detailed understanding of the target concepts to be taught. Because astrobiology is a new field of science bringing together many scientific fields of study, it presents a formidable challenge for most K–12 science teachers. The NASA-funded Center for Educational Resources (CERES) Project (URL: <http://btc.montana.edu/ceres/>) has designed a set of classroom activities and an accompanying Internet course for teaching astrobiology. These activities have been designed to combine on-line data resources from NASA with the student-centered inquiry instructional strategy emphasized in the National Science Education Standards. The activities have been developed and field-tested by pre-college science teachers and university faculty. The accompanying asynchronous Internet course is a 15-week, graduate-level course in astrobiology for teachers. The course integrates the NASA Astrobiology Roadmap, the NRC National Science Education Standards, and the astrobiology curriculum supplements available online at URL: <http://btc.montana.edu/ceres/astrobiology>. The two main goals of this course are: (1) to provide information on the central concepts related to the field of astrobiology, and (2) to provide experiences with using student-centered and inquiry-based curriculum materials for teaching astrobiology.

### Terrestrial planet formation in the Alpha Centauri system

Elisa V. Quintana • *NASA Ames; University of Michigan, Jack J. Lissauer • NASA Ames Research Center, John E. Chambers • NASA Ames, Martin J. Duncan • Queen's University*

Some of the 80 known extrasolar giant planets orbit stars which also possess a stellar companion, e.g. 16 Cygni B, Tau Bootis, and 55 Rho Cancri, confirming that planets can form in binary star systems. The radial velocity technique used to discover these planetary companions is able to detect only large (Jupiter-mass) planets, so the existence of Earth-sized planets in binary star systems still remains observationally unconstrained.

Herein, we examine planet formation around each star in the Alpha Centauri A and B binary system, the closest binary to the Sun. Each integration begins with a "bimodal" mass distribution of several large embryos embedded in a disk of smaller planetesimals orbiting a star, and we follow the evolution of the accreting bodies for 200 Myr–1 Gyr. Preliminary results suggest that systems with the initial inclination of the circumstellar disk above 45 degrees to the binary orbital plane cause most of the mass in the disk to rapidly fall into the primary star. When the disk began at a lower inclination, however, the simulations typically produced three to five terrestrial planets within 2 AU of the primary star, and on roughly circular ( $e < 0.2$ ) and roughly coplanar orbits.

### The runaway greenhouse effect on Earth and its implication for other planets

Maura Rabbette • *NASA Ames Research Center, Christopher McKay • NASA Ames Research Center, Peter Pilewskie • NASA Ames Research Center, Richard Young • NASA Ames Research Center, Sam Clanton • NASA Ames Research Center*

The primary greenhouse gas in the Earth's atmosphere is water vapor. It is an efficient absorber of outgoing long-wave infrared radiation.