EDITORIAL

Biodiversity 2010: the tip of the iceberg

In this year, the International Year of Biodiversity, we take a look at the mind-boggling scale of microbial biodiversity yet to be uncovered and the potential benefits of increasing our discovery efforts.

This year is the United Nations' International Year of Biodiversity, which provides us with an opportunity to take stock of efforts to assess the impact of human activities on global species diversity. In some of the more remote parts of the world, efforts to limit our impact seem to be having a positive effect. For example, in the 3 years since the Heart of Borneo became a protected area, 123 new plant and animal species have been discovered that may otherwise have been lost[1]. The goal of significantly reducing the rate of biodiversity loss by 2010 was set by world leaders in 2002 as part of the Millennium Development Goals; however, a recent report on the progress that has been made towards this goal found that species decline continues unabated[2].

The United Nations event focuses on plants and animals, but the majority of the biodiversity on this planet is unseen. Bacteria, archaea and viruses are the predominant forms of life on the planet; the total number of bacteria on Earth is estimated to be around 5×10^{30}. Indeed, the total biomass of bacteria is estimated to contain 3.5×10^{14} kg of carbon[3], similar to the amount in plants. However, in 2008 there were only ~7,000 accepted microbial species[4], far fewer than the number of plant (300,000) or animal (1,250,000) species. Clearly, this does not accurately reflect the total biodiversity of bacteria; in fact, only about 1% of the species in a given environment can be cultured. A 2002 estimate put the total number of bacterial and archaeal species at around 6 million[5]. However, the diversity in the ocean and in soil might have been underestimated in this study, indicating that the total diversity is likely to be even higher.

Why is microbial diversity important? First, microbial ecology plays a central part in the geochemistry of the planet. The more we understand the diverse organisms that are involved in global carbon and nitrogen cycles, the better we will understand how human activities affect these processes. This will enable us to develop informed strategies to address pressing global issues such as man-made climate change.

Second, microorganisms provide the best chance for discovery of new protein families. For example, a recent study showed that the rate of discovery of new mammalian protein families seems to be reaching a plateau, but the number of new families being discovered in bacteria is still increasing linearly with the number of genome sequences obtained[6]. Furthermore, synthetic biology is becoming increasingly sophisticated, with intricate pathways built *de novo* in bacteria to provide products for commercial purposes (such as precursors for artemisinin). A larger arsenal of potential components for such synthetic systems means that a greater diversity of products will be available. In addition, many secondary metabolites are antibiotics, and although it is difficult to predict their synthesis from a genome sequence, further investigations of the microbial diversity should provide opportunities to identify additional active compounds.

Finally, our understanding of microorganisms is heavily skewed towards pathogens and certain model organisms. This has obvious historical reasons, but it has perhaps blinded us to a world of interesting microbial biochemistry and physiology. New tools are allowing us an unprecedented view of bacterial species that were previously inaccessible. Recent calls to target under-represented branches of the bacterial tree of life for whole-genome sequencing will undoubtedly uncover even more novel genes and further underscore the tremendous diversity of bacteria.

The vast and undiscovered biodiversity found beneath our feet and in the oceans will provide us with an endless source of novel and interesting biology. With new tools and an increasing appreciation of the importance of microorganisms for global geochemical cycles, we can look forward to a fertile time for discovery of this microbial biodiversity and, perhaps, to an 'International Year of Microbial Diversity'.

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