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COMMENTARY

Microbes orchestrate life on Earth

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In the past decade, global climate change has come to the forefront of the political and social agenda owing to the growing realization that the Earth's resources are being used in an unsustainable fashion. There is an urgent need for changes in policy and human behaviour to tackle this problem, as well as a global initiative to develop a better understanding of global change processes and potential remedies for the future.

Microbial ecology lies at the heart of any discussion on sustainability. Indeed, from the natural environment to engineered systems, we rely on microorganisms to keep the globe turning and to sustainably maintain it, through the essential involvement of microorganisms in all biogeochemical and elemental cycles of the planet. To highlight the central role of microbial ecology in sustaining system Earth, as well as the potential of microbial processes to contribute to sustainable development, the *ISME Journal* and *Nature Reviews Microbiology* have joined forces to provide a joint focus on the importance of microorganisms in climatic processes and research that aims to harness the capabilities of microorganisms to provide new energy sources. This joint focus coincides with the theme of ISME-12, the premier microbial ecology meeting of the year, which will be held from 17 August 2008 to 22 August 2008, in Cairns, Australia: 'Microbial Diversity—Sustaining the Blue Planet'.

The ISMEJ/NRMICRO joint focus (http://www.nature.com/focus/sustainability) and ISME-12 will present important advances and perspectives that will illustrate how microorganisms shape the planet and how they likely hold the key to sustainable energy development in the future. Numerous ISME-12 sessions are dedicated to these pivotal topics. From bioremediation to plant growth promotion, from facilitating human and animal digestion to driving elemental cycles, from influencing global carbon turnover to cleaning water, we rely on the activities of microbial communities for providing ecosystem functions. These topics and more are highlighted in the sessions of ISME-12 (http://www.kenes.com/isme12/scientific.asp) where there will be seven plenary lectures delivered by legendary microbial ecologists including the 'Jim Tiedje Lecture' to be given by Norman Pace (Into the Natural Microbial World). Other plenary topics cover the deep biosphere (Bo Barker Jørgensen), the rare biosphere (Mitch Sogin), evolution of microbial communities (Paul Rainey), genetics of microbes in biofilms (Roberto Kolter), microbial life on a leaf (Steven Lindow) and microbial-driven symbioses (Nancy Moran). The ISME-12 Programme comprises 92 invited oral lectures, 182 proffered oral papers and more than 1200 proffered posters. Topics at ISME-12 complement those in this joint ISMEJ/NRMICRO edition—particularly, sustainable/alternative energy sources (including but not limited to 'microbial fuel cells') and global climate change.

The specially commissioned reviews that comprise the ISMEJ/NRMICRO joint publication focus not only on the examination of how microorganisms shape the Earth and its environment, but also consider how microbial traits likely contribute to issues of sustainable energy production. Future global change scenarios depend to a large extent on soil microbial ecology and terrestrial carbon cycle–climate feedbacks. The mini-review authored by Richard Bardgett, Chris Freeman and Nicholas Ostle (2008) explains how the complex interactions involved in the numerous potential negative and positive contributions of soil microorganisms influencing land–atmosphere carbon exchange and global warming. They highlight an urgent need to understand both direct and indirect impacts of climate change on microorganisms and examine how microbial activities might buffer against, or serve to amplify, global climatic changes.

Microorganisms have evolved to use every energy source available to them, so it is not surprising that researchers have turned to the activities of microorganisms to search for solutions to some of the world's growing energy problems. It is germane to this discussion that a major funder of microbial genome sequencing has been the US Department of Energy—if we can understand how microorganisms harness and produce energy, perhaps we can start to harness these microbial mechanisms to generate energy for human consumption. The review by Thauer *et al.* (2008) examines how methanogenic archaea conserve energy. By understanding the metabolism and cellular organization of methanogens with cytochromes versus those lacking these key proteins, these authors provide insights into the energetic strategies of these organisms, thereby not only presenting information relevant

to methane cycling, but also microbial energy strategies in general. Microorganisms possess enormous metabolic versatility, and no organism exemplifies this versatility better than *Shewanella oneidensis*. *Shewanella* spp. are veritable masters of biochemistry, being known to exploit a vast array of metabolic capabilities. Frederickson *et al*. (2008) outline a system-level approach to understanding the remarkable versatility of these bacteria, thereby providing insight into the evolution and adaptation of these important environmental engineers and potential microbial motors. In addition to the reviews highlighted above, the joint ISMEJ/NRMICRO focus on sustainability also brings together numerous other reviews and original papers from *Nature*, *ISME Journal*, *Nature Biotechnology* and *Nature Reviews Microbiology* in a library of articles to showcase this rapidly growing research area (http://www.nature.com/focus/sustainability).

Microbial ecologists have an incredibly important role to play in investigations into planetary sustainability. Microorganisms have ruled the planet for billions of years, and it is clear that mankind will have to appreciate this legacy to understand current and future changes to the Earth's environment, as well as to find solutions to the problem of how to sustain the burden that mankind has placed on planetary resources.

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