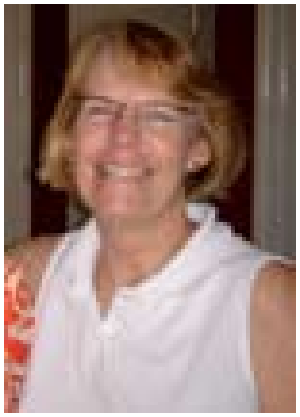
Microbial ecology



Linda L Blackall

Tel: (07) 3365 4645
Fax: (07) 3365 4726
Email: blackall@awmc.uq.edu.au

This issue of *Microbiology Australia* is devoted to the field of *microbial ecology,* currently rapidly growing into a mature, vibrant and exceptionally relevant component of the discipline of microbiology. Indeed, I maintain that all microbiologists are microbial ecologists since the field covers *the study of the interactions between living microorganisms and their environment.* Microbial ecology links those areas in which microbiologists are traditionally trained (biochemistry/chemistry/microbiology) with 'ecology', which is generally taught within the life sciences in our universities. '*Oekologie'* (ecology), coined by Ernst Haeckel in 1866, can be described as the scientific study of the distribution and abundance of living organisms and the interactions between organisms and their ecosystem including the biotic and abiotic components. Partly due to the channelling of microbiology students into the contemporary field of molecular biology, the majority of microbiologists are not exposed to ecology, and they are generally not aware that they are microbial ecologists.

All cellular microorganisms and viruses (including bacteriophages) interact closely with their environment whether that be the ocean (water column and sediment), human/animal respiratory tract, the soil, the intestinal tract (humans, marsupials, ruminants, termites, etc), the deep subsurface (terrestrial and oceanic), the oral cavity, antarctic lakes, the urinary and vaginal tracts, surfaces (leaves, skin, corals, prostheses etc) – in fact most environments on/in earth are colonised by microbes. The relationship microbes have with their environment is highly relevant to their survival and very often the environment is sustained by, maintained by, and dependent upon the presence of the microbes. In an article by Nick Coleman, in this issue of *Microbiology Australia* the so-called Gaia hypothesis is mentioned – this speculates that the living and non-living parts of earth should be viewed as a single organism and all living things have a regulatory effect on earth's environment. It must be pointed out that many of the elemental cycles on earth (carbon, nitrogen, phosphorus, sulfur) are completely dependent on microbes for their continuation.

Also in this issue you will learn about some of the exciting microbial ecology explorations carried out by (mostly) Australian microbial ecologists from Darwin, Brisbane, Sydney, Melbourne Perth and from Palmerston North, New Zealand. Topics covered include microbes in Antarctica, the living soil, animal gut microbiomes, coral-microbial associations, oral cavity microbes, biofilms, viral control of microbial systems, mining microbes, biogeo(micro)chemistry, and the role of microbes in environmental disturbance. There are papers on cutting edge methods like metagenomics and metaproteomics and one on the tremendously valuable role growing recalcitrant microbes plays in our understanding of microbial ecology.

Due to constraints of time and space, there are many amazing Australia-NZ microbial ecologists who are not represented in this issue and by way of recompense there follows just a few, very recent highlights from some.

In August 2006, Mike Manefield (University of New South Wales) won the prestigious Australian Museum Eureka Prize for Innovation and Leadership in Environmental Science.

In July 2007, International Society for Microbial Ecology (ISME) Ambassador Andrew Holmes (University of Sydney) won the prestigious Frank Fenner Research Award from the Australian Society for Microbiology and delivered an insightful plenary presentation on the role of integrons in microbiology.

Recently published are two excellent papers on microbial-sponge associations by early career Australia-NZ microbial ecologists; Nicole Webster [1] (Australian Institute for Marine Science) and Mike Taylor (*et al*) [2], recently arrived at The University of Auckland, NZ, from the University of Vienna, Austria.

Torsten Thomas, Suhelen Egan and colleagues [3] (The University of New South Wales) have lately published a paper on novel molecular method integration in marine environments.

Mahomed Patel [4] (National Centre for Epidemiology and Population Health, Canberra) recently reported on trends in meningococcal disease (MD) during the 20th century in Australia, stating...

> *A rising incidence of MD should not be viewed as the action of a virulent microbe exploiting a vulnerable population, but as the emergence of an 'accidental pathogen' from an evolving host-microbial ecology. While it is essential to monitor the impact of vaccines on this ecology, we must find ways that can optimise our co-existence with microbes.*

Finally, nearly completed PhD student Gabriel Milinovich [5] (with colleagues at the Veterinary School at the University of Queensland), has published groundbreaking research findings from his study on the microbial ecology of horse hind guts and its role in laminitis, in the high impact journal *Environmental Microbiology.*

Let me say there are many more great Australian microbial ecologists not included here or amongst the authors of this issue.

Microbial ecology studies have revealed astonishing facts including that the normal human houses about 10^{12} bacteria on the skin, 10^{10} in the mouth and 10^{14} in the gastrointestinal tract; there are 100 times as many microbes in and on your body than you have of human cells!; and microbial ecology is a crucial component in all diseases of humans, animals and plants, and many are polymicrobial-host associations.

The indigenous microbes of the gastrointestinal (GI) tract of an animal have an incredible impact on their host, including synthesis and excretion of vitamins, prevention of colonisation by pathogens, antagonisation of other bacteria through the production of inhibiting substances, stimulation of the development of certain tissues (e.g. the caecum and certain lymphatic tissues (Peyer's patches) in the GI tract, and induction of immunological responses.

I imagine that most of you do not know that the planet earth holds 10^{31} viruses in the oceans alone and their biomass equals 200 megatonnes of carbon – the equivalent of 75 million blue whales. Stretched end-to-end, oceanic viruses would span 10 million light years (see the paper by Peter Pollard in this issue).

According to Tom Curtis and William Sloan [6], exploring microbial diversity is like exploring outer space with soil being a "final frontier", harbouring a largely unknown microbial universe. There are more than 10^{16} microbes in a ton of soil compared with a mere 10^{11} stars in our galaxy and estimates of the number of microbes in soils are short by almost three orders of magnitude.

Ponder this slightly modified comment from Tom Curtis [7]:

> *If the last blue whale on earth choked to death on the last panda, we would all be very upset. But if the last two species of ammonia-oxidizing bacteria became extinct, it would be the end of life on earth …that could be happening now but we wouldn't even know…*

The penultimate point I wish to make in this editorial is that a strong motivation for devoting this issue of MA to microbial ecology was to inform Australian microbiologists of the fact that the *12th International Society for Microbial Ecology congress will be in Cairns, Queensland, Australia, on 17–22 August 2008 (http://www.microbes.org/isme).* This conference is expected to attract 2,000 microbial ecologists from all over the world and, as chairman of the organising committee, I invite you all to attend. Staffan Kjelleberg (see article in this issue) is the immediate past president of ISME and both he and I are current board members of ISME. Andrew Holmes is the ISME Australian ambassador. For membership of ISME, go to the above web page.

Finally, the first issue of a new journal owned by ISME, *The ISME Journal*, was launched on 1 May 2007. The journal is published by the Nature Publishing Group (NPG) (www.nature.com/ismej) and is currently available to all, free online. The joint ISME and NPG gaol is that this new journal will have the highest impact of any journal in the field within the next three years. Now that's a challenge!

Happy reading.

References

1. Webster N. Sponge disease: a global threat? *Environ Microbiol* 2007; 9:1363-75.
2. Taylor MW, Radax R, Steger D *et al.* Sponge-Associated Microorganisms: Evolution, Ecology, and Biotechnological Potential. *Microbiol Mol Biol Rev,* 2007; 71:295-347.
3. Thomas T, Egan S, Burg D *et al*. Integration of genomics and proteomics into marine microbial ecology. *Mar Ecol Prog Ser,* 2007; 332:291-9.
4. Patel MS. Australia's century of meningococcal disease: development and the changing ecology of an accidental pathogen. *Med J Aust,* 2007; 186:136-41.
5. Milinovich GJ, Trott DJ, Burrell PC *et al*. Fluorescence *in situ* hybridization analysis of hindgut bacteria associated with the development of equine laminitis. *Environ Microbiol* 2007; 9:2090-100.
6. Curtis TP, Sloan WT. Exploring Microbial Diversity – A Vast Below. *Science,* 2005; 309:1331-3.
7. Curtis T. 2006 Microbial ecologists: it's time to 'go large'. *Nature Rev Microbiol* 4:488.

MICRO-FACT

Microbial ecology is the study of the interactions between living microorganisms and their environment.