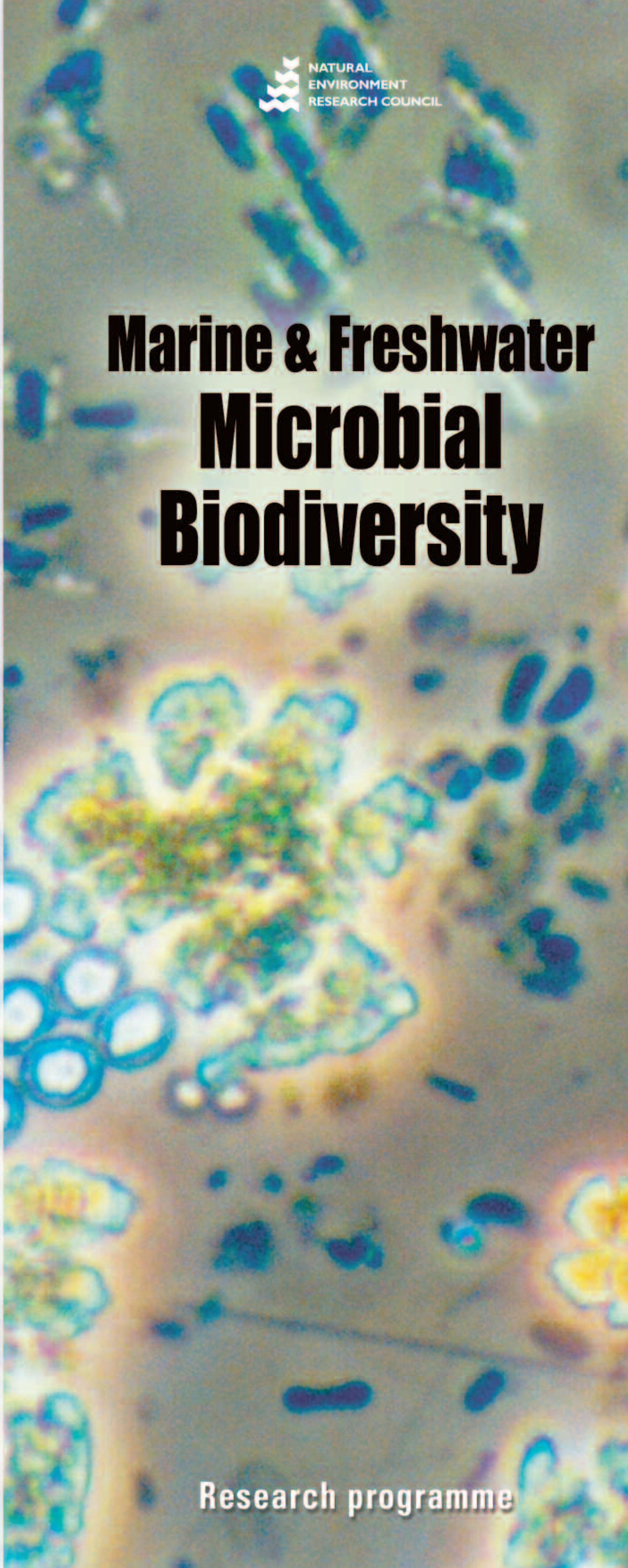

NATURAL ENVIRONMENT RESEARCH COUNCIL

Marine & Freshwater Microbial Biodiversity

Research programme

NERC is investing £7 million in the Marine and Freshwater Microbial Biodiversity programme between 2000 and 2005. To see which research groups and organisations are involved in the programme, visit www.nerc.ac.uk/m&fmb

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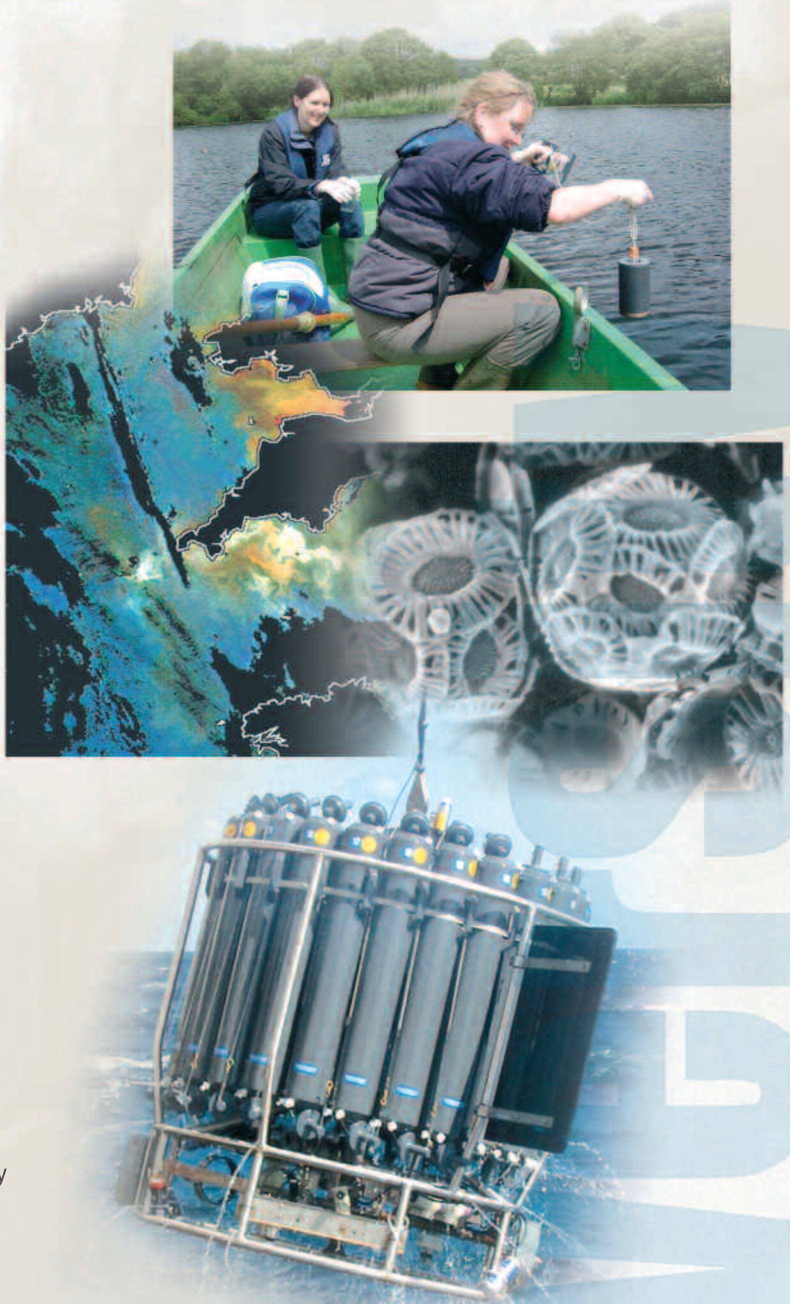
British Oceanographic Data Centre
www.bodc.ac.uk/projects/mfmb
Environmental Genomics
www.nerc.ac.uk/egenomics
UK National Culture Collection
www.ukncc.co.uk
Society for General Microbiology
www.socgenmicrobiol.org.uk
International Geosphere-Biosphere Programme
www.igbp.kva.se

Picture credits: Ian Head, Willie Wilson, RSDAS/PML.

Small in size - big in importance

Microbes matter. We associate them mostly with disease, and ignore the unseen but vital role that bacteria, viruses and single-celled plants and animals play in providing a habitable planet. They control atmospheric composition and climate, soil fertility, and the global cycling of elements between land, rivers and ocean. They have been doing this for over 3,500 million years.

The study of microbes is difficult because many look much the same, even with the best microscopes. Since there are many millions in a teaspoon of seawater, we still cannot answer basic questions such as: how many different kinds are there? what are they all doing? what controls their numbers and activities? The Natural Environment Research Council (NERC) is helping to find the answers through its Marine and Freshwater Microbial Biodiversity programme (M&FMB). Our findings have a practical purpose as well as a scientific one. Microbes synthesise many thousands of compounds with biotechnological potential, yet we currently know and exploit a very small fraction of them.



Characterising and counting

One basic challenge for the programme is to assess the diversity of microbes. Are there more than a million types of microbes in the ocean or just a few thousand? Are the same bacteria and protists (single celled animals) found throughout the world in similar freshwater habitats, or does each locality or region contain organisms found nowhere else? Whereas the classification of microbes used to be based on external form, these days it is increasingly based on their genetic make-up. There have been many surprises. A few years ago, researchers discovered a new marine bacterium. Once they had described its genetic identity it turned up everywhere, and it is now believed to be one of the most common species on our planet. If we know what groups of microbes are genetically related, we can be more effective in our search for novel compounds of medical and industrial benefit.

Culturing the uncultured

Around 99% of microbes cannot be isolated and grown in a laboratory using standard methods. As a result, we only really know about the very few species that we can grow as pure cultures. These are probably untypical, and are unlikely to be the most important, either ecologically or for biotechnological applications. We are therefore putting considerable effort into cultivating novel strains, including those from deep-sea sediments. Two-fifths of the top-selling drugs are derived from the relatively small minority of microbes that we can easily study in laboratories. Imagine the possibilities…

Chemical communication and microbe wars

Microbes ‘talk’ to each other using chemical signals. Deciphering this chemical language is critical to understanding microbial processes and behaviour. Such communication can be surprisingly sophisticated. Signal molecules exchanged between bacteria can coordinate the activity and state (active or dormant) of entire populations, and can be detected by other groups, such as algae. Microbes also use chemicals for aggressive purposes. Bacteria such as Actinomycetes use antibiotics to kill other bacteria. By looking at how microbes use chemicals, we can learn how to use them ourselves.

Viral dynamics

Humans are not the only species to suffer from viral infections. Viruses can multiply or stay dormant in almost every life form, including bacteria and amoebae. One of our research teams has described a previously unknown group of viruses that live in microscopic marine algae and can apparently control their blooms, with effects visible from space. When they kill their hosts, energy-rich cell contents spill into the water where they are recycled by bacteria, rather than being transferred up the food chain to invertebrates and fish. Understanding the natural importance of viruses will give us a better grip on how nutrients and chemicals cycle through the Earth system.

Related work elsewhere

The M&FMB programme has links with two other NERC thematic programmes, Environmental Genomics and Soil Biodiversity. We also collaborate with the Biotechnology and Biological Sciences Research Council. International links include many EU projects and global change programmes that address the interactions between microbial biodiversity and biogeochemistry, such as the Joint Global Ocean Flux Study and the developing Oceans initiative.