10.1071_ISSN0311-4546EC104p32

sharing the limelight

May was an extraordinary month for CSIRO marine scientist Dr Shirley Jeffrey. At a ceremony in Washington DC, she received the Gilbert Morgan Smith Medal for excellence in marine or freshwater research, and was later elected as a foreign associate of the United States National Academy of Sciences. Sixteen other Australian scientists are associates of the academy, but the Gilbert Morgan Smith Medal has not previously been bestowed outside the US.

The award recognises Jeffrey's contributions to biological oceanography and the provision of live algal cultures for international research. Her readiness to share the limelight with her prime research subjects – marine microalgae – hints at the satisfaction she has derived from rescuing these tiny plants from scientific obscurity.

'The award, and my election to the academy, are evidence that microalgae research has truly come of age in the past 20 years, and that the significance of these beautiful, diverse and important microscopic plants is now being recognised,' Jeffrey says.

'I would like to thank CSIRO for supporting what began as basic research at a time when knowledge in the field was very limited. We now know so much more about the role of microalgae in the ocean, their diversity, their particular habitats, and how to grow them in the laboratory. We can also isolate and describe the photosynthetic pigments that characterise the different algal groups, making it possible to measure the amount of microalgae in the oceans on a global scale.'

Jeffrey's career in marine science began with her appointment to the CSIRO Division of Oceanography and Fisheries at Cronulla in Sydney, and a somewhat daunting directive to find out what plant pigments were in the ocean.

'Different pigments characterise different types of microscopic algae, the single-celled plants upon which all other marine life depends,' Jeffrey says. 'My task was to develop a simple chemical test to measure the quantity and types of algal species in a water sample from the pigments present, thereby saving hours of time laboriously identifying algae under a microscope.'

This was new territory for Jeffrey, whose doctoral research at King's College Medical School, London University, was on the effect of aspirin on carbohydrate metabolism. Nevertheless, she became the first person in the world to extract pure chlorophyll c, a pigment found only in marine plants.

Unlike land plants, which have the whole light spectrum available for photosynthesis, marine plants have adapted to the ocean's restricted light conditions. Each algal group contains a suite of pigments suited to its particular

Bruce Miller

Left: Dr Shirley Jeffrey of CSIRO Marine Research: the first person outside the US to be awarded the national academy's Gilbert Morgan Smith Medal for excellence in marine or freshwater research.

Right: Boots and all: Jeffrey and colleague Jeannie-Marie Leroi examine microalgal production at the Shellfish Culture oyster nursery near Hobart.

Below: The tropical coccolithophorid, *Scyphosphaera apsteinii* (diameter 40 mm) carries disc-shaped and vase-shaped calcite structures on the cell surface. Spectacular arrays of calcite crystals (coccoliths) such as these were known from fossil sediments in the 18th century, but their biological origin was only discovered years later when swimming coccospheres were seen live in seawater samples. Closely related bloom species, such as *Emiliania huxleyi*, contribute significantly to the limestone sediments of the ocean floor, act as a sink for inorganic carbon, and emit sulfate aerosols which act as cloud-seeding nuclei, profoundly affecting regional climates. (Micrograph courtesy of Dr GM Hallegraeff.)

light environment. For example, shallow-water species may have different pigments from microalgae from depths of 50–60 metres, where light is scarce. This means different algal groups can be recognised by their characteristic light absorption signature.

Jeffrey recognised that standard techniques for pigment extraction were crucial to their reliable identification. She developed simple extraction procedures for individual species and algal groups, and characterised their light-absorption properties. The resulting signatures are used worldwide to classify algal types.

The characterisation of algal pigments opened the way for global mapping of marine microalgae in the world's oceans, using light sensors on satellites to record ocean colour. 'With microalgae making up more than a quarter of the total vegetation of the planet, they are of key importance to a world concerned with global warming and climate change because of their role in the marine carbon cycle and marine organic sedimentation processes,' Jeffrey says.

'They can alter climatic processes by emitting volatile sulfur compounds that act as cloud-seeding nuclei, profoundly affecting regional climates. In time, toxic algal blooms – which contain special UV-protecting pigments – may be also monitored from space, allowing quicker assessment of danger zones in our regional oceans.'

Much of Jeffrey's career has been devoted to the CSIRO Algal Culture Collection: gathering and isolating microalgal strains, and developing techniques and facilities to culture and store them.

This resource proved invaluable in the 1980s, when Jeffrey and her colleagues were asked by industry to develop microalgae starter feeds for aquaculture production. They tested microalgal strains for the right temperature tolerance, nutritional value, size, shape and digestibility to suit particular aquaculture species. Disease-free algal cultures were provided to Australian hatcheries, and training given to industry personnel in mass algal culture techniques and ways of minimising contamination.

The algal culture collection, now known as the CSIRO Collection of Living Microalgae, is housed in specialist facilities at the Hobart laboratories of CSIRO Marine Research. It contains 700 strains representing more than 300 microalgae species, and continues to supply specialist cultures to the aquaculture industry and research laboratories worldwide. Many of the microalgae contain compounds such as fatty acids and vitamins, which are being screened for their potential use in human nutrition and disease prevention.

Jeffrey's work is summarised in *Phytoplankton Pigments in Oceanography*, published by UNESCO in 1997. An international effort, the book is a culmination of her scientific contributions which amount to more than 100 published works.

Katie Johnson and Bryony Bennett