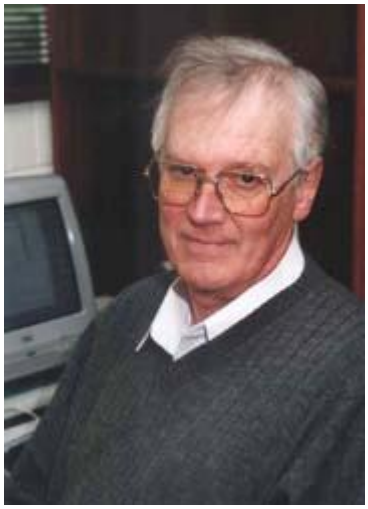
Professor Arthur McComb



MSc (Melb.), PhD (Cantab), F. Inst. Biol., FAA

Emeritus Professor Arthur McComb of Murdoch University is a very senior and well-regarded Australian marine scientist. Arthur has had a long and distinguished career in the field and still contributes to marine science at a high level of scholarship and productivity that would be the envy of a person half his age. We are pleased attach a list of Arthur's achievements and awards he has already received in for his contributions to Australian science.

Arthur McComb was born in Melbourne, on 9th December 1936, and graduated with both a BSc and MSc from the University of Melbourne. He then undertook his PhD at the University of Cambridge, graduating in 1962.

With a strong background in experimental plant physiology, Arthur is an expert on the control of plant growth in aquatic systems. Most of Arthur's research has concerned with the control of plant growth, at first with emphasis on plant physiological work in the laboratory, and later with plants in the environment, broadening to ecosystem function. From 1982 onwards Arthur has been awarded, with research collaborators, grants totalling some $ 6 million, mostly for the work on water quality.

Arthur has published more than 120 papers, many of them concerned with eutrophication in nearshore systems, estuaries and wetlands. Over 30 students have completed PhD's under his supervision, 3 of whom hold chairs, 2 of them at European universities. His former students are spread throughout Australian science in universities, state government departments and consulting firms, confirming his influence on the understanding and management of marine, estuarine and freshwater systems. Arthur has written or edited 6 books, including volumes on seagrasses, Australian wetlands, and eutrophic shallow estuaries and lagoons. He was elected to the Australian Academy of Science on 27th April 1996.

The underlying theme of Arthur's research has been to understand the fundamental processes which control plant biomass in aquatic systems, and while this has had a strong physiological basis - for example the control of plant production by light and nutrients - it broadened to understanding the place of primary producers in the functioning of whole ecosystems. It recognises that all aquatic systems, from freshwater to marine, share many features which are important in ecosystem function and management. His work has been of considerable management significance, especially in relation to the accession of nutrients from catchments and their effects in receiving waters. Examples include the Blackwood River Estuary in southwestern Australia, Cockburn Sound, a marine embayment to the south of Perth, and the Peel--Harvey Estuarine System. More recently he has been active in guiding and evaluating the $ 10 million research program of Cockburn Cement Limited in their Environmental Management Plan for shellsand dredging on Success Bank south of Perth. These systems are vulnerable to management decisions affecting their catchments, including point sources of nutrients such as industry and diffuse sources such as agriculture. This concept has led Arthur to become involved more generally in the management and conservation of these systems. This work has led to studies on the management of other estuaries in Western Australia, and to Arthur's involvement in advisory

committees (including the scientific advisory committee of the Port Philip Bay Study in Victoria), and meetings about algal blooms in the Murray-Darling Basin, and other government agencies.

Professor Arthur McComb has had a seminal influence on a generation of researchers. His gentle unassuming manner combined with his effectiveness and incisive thinking have resulted in major shifts in our understanding of aquatic ecosystems. Three examples are given below:

The first main program concerned Cockburn Sound, a marine embayment adjoining a recently industrialised area on the eastern shoreline of the Sound. Seagrasses had died back in the Sound, and subsequently phytoplankton blooms had become prominent The death of seagrass was traced to enhanced growth of algal epiphytes on leaf surfaces, while the distribution of nutrients and phytoplankton in the water established the primary cause of nutrient enrichment as a fertiliser works, with a sewage works becoming more important as the population of Perth increased. These studies were instrumental in the State Government deciding to expend some $M40 in re-routing the sewage effluent to a more appropriate site, while industry responded by reducing levels of wastes entering the Sound.

The second program was a study on the Peel-Harvey system, which consists of two estuarine basins near a coastal resort (Mandurah) 70 km south of Perth. Both basins showed evidence of intense eutrophication, with accumulations of macroalgae and extensive blue-green algal blooms. The cause of eutrophication was established as nutrients derived from the river systems, and collaborative work with the then Department of Conservation and Environment, the Department of Agriculture and other institutions, together with a management study which Arthur jointly directed, led to the conclusion that altered procedures for applying fertiliser to the L-M surface will improve the estuary, but that a dramatic improvement in the short-term would only be achieved by cutting a new channel to the ocean. These proposals have been accepted; the channel was constructed at a cost of some $ 37 million, and there have been no subsequent blue-green blooms.

The third program is the controversial Cockburn Cement shellsand mining program on Success Bank. The bank is a high quality calcium carbonate deposit which is being mined to produce lime and cement used in many industries in Western Australia. A mixture of seagrasses occurs on parts of the bank. With the experience of the loss of seagrasses in Cockburn Sound to the south, removal of the seagrasses has attracted considerable controversy. Arthur has been instrumental in overseeing the research being undertaken on the ecological significance of seagrasses as one of three members of Cockburn's Environmental Management Advisory Board. The research has demonstrated that many of our paradigms for seagrasses, which are largely based on enclosed systems, are inappropriate on the exposed Success Bank. The Environmental Review and Management Plan which resulted from the research has recently been approved by the Western Australian Environmental Protection Authority.

Appointments - Arthur McComb

Murdoch University

1996-present Emeritus Professor, Chairman, Centre for Organic Waste Management
1989-1996 -Professor of Environmental Science
1989-1994 -Director, Institute for Environmental Science

University of Western Australia

Lecturer to Associate Professor in Botany
1981-1986- Head of Department
1982-1997- Joint Director, Centre for Water Research

Other

1983 Research Fellow, Botany Department, University of Melbourne
1976 Visiting Fellow Department of Botany, University of Leicester
1969 Research Associate, Plant Research Laboratories, Michigan State University.

Previous Honours

Fellow of the Institute for Biology and the Australian Institute for Biology, elected 1989.
Hilary Jolly Award, Australian Society for Limnology, 1991
Fellow of the Australian Academy of Science, elected 1995.
Royal Society of Western Australia, Medal for 1997 and Honorary Life Member
Named lecture to acknowledge contributions of Arthur McComb to Limnology, presented by Dr Margaret Brock of the Botany Department, University of New England, at the annual meeting of the Australian Society for Limnology, 1998, in Queensland.

Honorary Positions

1971-1976: Editor, Journal of the Royal Society of WA
1976-1980: Editorial Advisory Committee, Australian Journal of Botany
1978: President, Royal Society of WA
1984-1986: Scientific Advisory Committee, World Wildlife Fund Australia
1985-1987: Deputy Chair, WA National Parks and Nature Conservation Authority
1990-1995: Chair, WA National Parks and Nature Conservation Authority
1988-1989: Chair, WA Lands and Forests Commission
1987-1988: President, Ecological Society of Australia
1992: Member, Technical Advisory Group on generation of algal blooms in the Murray/Darling basin
1991-92: Life Sciences Panel, Cooperative Research Centre Scheme

Current Administrative & Advisory Roles

Chairman, Committee for Coastal Development, Murdoch
On the invitation of the Minister for Environment, Chairman of Community Liaison Committee and Independent Adviser to the EPA, Stephenson & Ward Incinerator, Welshpool
Chairman, Steering Committee for lectureship in Waste Management, Murdoch University
Member, Industry Liaison Committee, Institute for Environmental Science, Murdoch University
Member, Environmental Management Advisory Board, Cockburn Cement Ltd
Member Port Phillip Bay Study Advisory Committee
Member, Research Advisory Committee for Capel Wetlands, RGC Mineral Sands

Silver Jubilee Presentation

From Fenlands to Seagrass Meadows

I thought that I might try to explain how it is that a landlubber like me should be rewarded for contributions to marine science. To do this I need to expand a little on my background, and mention a few of the people who have influenced my career. This is not just self indulgence, as I would like to mention some of the students and colleagues whose collaboration has led to the award.

It is easy to look back on a career and define the path along which someone has moved. The path I trod might suggest that I carefully mapped this out and moved along it with confidence. Nothing could be further from the truth. As you will see, I have been unashamedly opportunistic, moving into new areas when a

path has opened up, often because of the interests of research students, the vagaries of funding, and the constraints of academia.

Background in Plant Physiology, University of Melbourne

My background is in plant physiology. It is 45 years since I graduated in Botany at the University of Melbourne, having done an undergraduate project on a genus of wetland plants. I then worked for a Masters degree under the supervision of Denis Carr. Denis was a stimulating personality with a daunting intellect, and he demonstrated to me, by example, the importance of treating research students as colleagues, and of publishing their results as soon as practicable. We worked on a group of plant growth-regulating chemicals known as gibberellins, which have spectacular effects on plant growth, and had only recently come to the attention of plant physiologists. My first publication was a note to Die Naturwissenschaften, and was about the way gibberellic acid could replace the need for cold treatment, or vernalization, normally obligatory before a biennial rosette plant will shoot up and flower under long days. I can remember the excitement of seeing the reprints of my first publication, and the satisfaction is still there of finalising a piece of research and seeing it published, despite many later contributions. Then there was the excitement of receiving reprint request cards. Now largely a thing of the past, thanks to photocopying and downloading from on line journals, reprint requests gave you a good idea of who was reading your papers, and a thrill when someone well known in the field requested a reprint.

PhD in Cambridge

In 1959 I was appointed an overseas scholar by the Royal Commission for the Exhibition of 1851. I set off for the Botany School in Cambridge, where I did a PhD under the supervision of Martin Canny. Martin was an expert in the translocation of chemicals in plants. A meticulous experimental scientist and writer of scientific prose, like Denis Carr he was an enthusiast of the rapid publication of research results. I like to think that something of the excellence of Martin's style of supervision has rubbed off on me.

With Martin I prepared gibberellic acid labelled with isotopic carbon by feeding a fungal culture with labelled acetate, and used it to study the stability and transport of gibberellic acid in pea seedlings. And incidentally I took an interest in the vegetation and management of the fenlands near Cambridge.

Return to Australia

In the early 1960s Australian universities were rapidly expanding, and so it was, that fresh out of my PhD in 1962, I took up a lectureship in the Botany Department of the University of Western Australia. How different from the situation today when PhDs might have to spend 10 years or so in postdoc positions before obtaining an appointment that allows them to set up their own research group. I wrote lectures, ran prac classes, began to build up equipment, obtained research funding, and had soon had Ph D students of my own, the first of more than 30 it has been my privilege to have as colleagues. I cannot talk about all of them today, but I might mention the first three for your interest, then sketch in some of the subsequent ones, emphasising their links with marine science.

First research students

My first research students had projects quite close to my own earlier interests. Bill Broughton studied the biochemical changes which occur in pea stems after treatment with gibberellin, Bob Jennings the possible importance of growth regulators in algae, and Wong Chee Hoong the anatomical changes brought about by gibberellin in a small aquatic plant.

Later student projects moved progressively further from my earlier research and, largely because of student interests, I became progressively more involved in things ecological.

One of my first ecological publications came early in my time at UWA, when I collaborated with my future wife, Jen, in documenting the wetland vegetation of Loch McNess, in the Yanchep National Park. Jen points out that it is not hard for a relationship to last 36 years if it survives the mud, blister bush and mosquitos of the Yanchep fens.

Eutrophication

I became attracted to understand something of what controls plant growth and productivity in the aquatic environment, and especially the effects of nutrient enrichment and its consequences, or eutrophication. I began to sort out my ideas by lecturing on the topic, and discussed with Bob Congdon the possibility of an honours degree. We chose to work on an enriched urban wetland, Lake Joondalup, and Bob set about implementing a suite of techniques for nutrient analysis, which were to lay the foundation for an ongoing nutrient analysis facility. Other students wanted to be involved, and soon Max Finlayson, David Gordon and Robert Atkins were undertaking honours degrees on related topics.

Blackwood River Estuary

Bob Congdon was meanwhile looking for a suitable PhD topic, and with the encouragement of the late Ernest Hodgkin, decided to work on the then very topical Blackwood River Estuary. Our facet of a broad study was to define and understand the main primary producers in the system. We concentrated on the fringing marshes, and on the 'seagrass' Ruppia, addressing what effect increased turbidity might have on the productivity of this submerged plant. One of the things I came to learn from Hodge was that it is quite possible to make a contribution to science after retirement.

During the Blackwood River study I came to interact with Jorg Imberger and one of his students, and quickly came to appreciate the intellectual stimulation of understanding physical processes in water bodies as a backdrop to interpreting the biological processes taking place in them. I was also struck with the way in which significant physical questions could be posed, and answered, while we biologists were still defining such general things as the main primary producers in the system. This was a lesson for the future.

While the Blackwood study was running to completion, our attention was drawn to eutrophication problems in two areas. The first was the nearshore marine area of Cockburn Sound, where there had been reports of phytoplankton blooms and the possible loss of seagrass.

Cockburn Sound

As part of the Cockburn Sound study, directed by Graham Chittleborough, Marion Cambridge joined us to find out if seagrasses had in fact declined, and if so to seek an explanation. Well, the seagrasses had declined, and the time course of decline coincided with the establishment of industry along the shore.

At the same time, Tony Chiffings was working with us on nutrient concentrations, loads and distribution in the Sound, and it emerged that nitrogen availability is of critical importance to the growth of phytoplankton in the water column, and that an increasing nitrogen load was deriving from industry and a sewage outfall. With Perth's population set to expand, the nitrogen load would increase further.

Putting these things together, the simplest hypothesis to explain the loss of seagrass was that increasing loads of epiphytic alga attached to seagrass leaves so reduced the light available for leaf photosynthesis that seagrass survival was impaired. Katie Silberstein tested this hypothesis in an honours project, and found in field and laboratory studies that the reduction in light by epiphyte shading was of the order demanded by the hypothesis. There were other studies by our group, for example on effect of oil refinery effluent, and studies in which we were not directly involved, including investigations of fish stocks and heavy metals. The Cockburn Sound Study led to a

strategy in which a sewage line and outfall were constructed to bypass the Sound and discharge further offshore, while industry reduced its discharge of nutrients.

One spinoff from the study was the early realisation by Marion that the most common seagrass in the Sound had not been sufficiently well described in the taxonomic literature, and it seemed an anatomical approach would be needed. Marion drew this to the attention of John Kuo, who had come to Botany as a post doc with advanced skills in electron microscopy and anatomy. John helped, and collaborated with Marion in revising a number of species in the genus Posidonia. John has gone on to become well known internationally for his expertise in seagrass taxonomy. For me, the Cockburn Sound Study also lead to an ongoing interest in seagrasses, and realisation that the ecology of submerged seagrass meadows has much in common with that of terrestrial fen vegetation.

Peel-Harvey

The second major eutrophication problem to which our attention was drawn, this time by Ernest Hodgkin, was in the Peel-Harvey Estuarine system. Massive accumulations of macroalgae were occurring in Peel Inlet, and noxious blooms of the blue-green alga (cyanobacterium) Nodularia in Harvey Estuary. Our task was to understand the reasons for these excessive growths, with a view to their management. Our labs mounted the nutrient analyses and plant studies, and we collaborated with others concerned with catchment management, fish and crustacean populations, and numerical modelling.

In contrast to the more marine Cockburn Sound, the main problem turned out to be phosphorus derived from the catchment. With phosphorus available, nitrogen could then be in relatively short supply for plant growth.

David Gordon did his Ph.D on one of the main species of green alga accumulating in the system, Rod Lukatelich explored the relation between nutrient availability, water movement and the growth of phytoplankton, and later Paul Lavery investigated why the dominant species of macroalga changed over the years.

The conclusion of the Peel-Harvey study was that catchment management should be used to reduce P loading from catchments, while improved exchange of nutrient-rich water from the estuary with nutrient poor water of the ocean would also be needed, and construction of the Dawesville Channel was proposed. Since its construction there have been no Nodularia blooms, and accumulations of macroalgae appear to be lessening.

Other Systems

I became involved in projects on other estuaries. In the Swan-Canning system, Jacob John of Curtin University brought his skill in diatom taxonomy to a PhD on changes in the diatom flora in relation to environmental factors, Karen Hillman studied the ecology of the seagrass Halophila and its significance to food webs, and Ray Masini began his work on microphytobenthos. With the growing expertise in aquatic systems, before long Chris Simpson was studying environmental impacts on corals in the Dampier archipelago, David Gordon took up a postdoctoral position to work on mangroves, and Eric Paling studied nearshore nutrient cycling.

Collaboration with CSIRO

Collaboration increased with the CSIRO laboratories at Marmion, where with Bill Wiebe I supervised the PhD of Hugh Kirkman on the kelp Ecklonia, of Judi Hansen on the dynamics of beach wrack, and Bill Wood began his study on the light climate of Ecklonia.

Shark Bay

In another development, several departments at UWA decided to collaborate in marine science by studying an ecosystem where most of us had not worked before, and the Shark Bay study was born. The Botany slice of the study was to attract a postdoctoral fellow to study the ecology of the Shark Bay seagrasses, so obviously important in the food webs of the system. Di Walker was recruited, and quickly established a program of seagrass research of international significance, eventually joining the academic staff of the Department.

Centre for Water Research

In the University's Department of Civil Engineering Professor Jorg Imberger was receiving substantial support from Government Departments for his work on reservoir dynamics, while my group was being funded by other departments for estuarine and near-shore marine work. In the perpetual quest by academics for stability in research funding, it made sense to put these things together , and a Centre for Water Research was formed, with Jorg and I as co-directors, my group addressing mainly plant-related issues such as seagrasses and phytoplankton, Jorg's group mainly physical matters such as stratification, mixing and light penetration. The Centre was to become an ongoing feature of aquatic science in the State.

Appointment at Murdoch University

In 1989 I accepted the position of Professor of Environmental Science at Murdoch University. Jen was already on the staff at Murdoch, and at last we could drive to work in one car! With the support of both universities and of funding agencies, I was able to transfer a number of ongoing research projects to Murdoch, with associated equipment and personnel. This included the nutrient analysis facility, which moved into a refurbished laboratory area, and has grown into the NATA- registered Marine and Freshwater Research laboratory, self funded and managed by Jenny Hale under the direction of Eric Paling. For a time Jorg and I tried to keep the Centre for Water Research operating across the two universities, but this proved impracticable.

I felt philosophically at home at Murdoch, with its emphasis on applied research, and was soon heavily involved in designing new courses on wetlands and estuaries, and administering a diverse department, with activities ranging from atmospheric science to waste management and environmental impact assessment, as well as teaching and research in marine science. Research on wetlands expanded in collaboration with Jenny Davis, Jane Chambers and others, and we have a wetland modelling project which involves staff of the Centre for Water Research at UWA, as well as Edith Cowan university. Studies on estuarine marshes and wetland sediments have been actively pursued, along with work on seagrasses, with participation of Eric Paling in seagrass transplantation.

Involvement in Management Authorities

I like the idea of scientists being involved in issues broader than just their own research. My personal outlet for this has been involvement in bodies with management responsibilities, culminating in becoming Chairman of the National Parks and Nature Conservation Authority, the 'NPNCA' in which National Parks and Nature reserves on land were formerly vested, along with marine parks and marine nature reserves.

This marked a new period of intense activity and interest, in which discussion often focussed on issues such as mining in national parks and nature reserves, oil exploitation on island reserves, desirable fire frequencies, kangaroo culling, and management of fishing in areas of conservation significance. At the suggestion of Des Lord I joined an Environmental Management Advisory Board set up by Cockburn Cement to help steer research to underpin an Environmental Review and Management plan for the ongoing harvesting of shells and from seagrass areas, for the manufacture of lime. The spell on NPNCA had shown me the value of collaboration with industry in carrying out research of high quality so that informed decisions can be made.

Health Problems

Then came a more brutal return to the consequences of gene-environment interaction, when further investigation of the high blood pressure which had precluded me from SCUBA diving lead to a spell in hospital for bypass and carotid artery surgery. During this I sustained a stroke which kept me in hospital for 3 months learning again to speak, walk and read easily. Reading the proofs of a book I had edited on *Eutrophic Shallow Estuaries and Lagoons* provided an aid to rehabilitation!

I am left with fascinating spatial problems. Living with them is a constant challenge, and is the main reason I stumbled when reading these notes. I returned to Murdoch on a half-time basis, then retired at the age of 60, which I had long planned to do.

Centre for Organic Waste Management

Which brings me to the most recent phase of my career. Murdoch declared me an Emeritus Professor, and appointed me "Senior Scholar in Residence" in Environmental Science, which allows me an office and some administrative support. We had received funding under the State Government Centres of Excellence Scheme to establish a Centre for Organic Waste Management at Murdoch. I chair the Board of Management, and advise the Director.

Organic Waste Management may seem a long way from my previous interests, but this is not so. When a large amount of organic material becomes available in the environment, much the same microbial processes are set in train, utilising the material as a source of energy and nutrients, whether that material be sewage sludge, lawn clippings, detritus in a seagrass meadow, beach wrack, the sediment surface in a wetland, or the gut of a dugong.

So I come to work 3 days each week, interact with research students, and edit draft theses and publications. What could be nicer?

Overview

Reflecting on my career, I like to think that my main role has been to provide an environment in which others have realised their potential. I reiterate that I have been immensely fortunate to have had such a succession of talented research students and collaborators. I have also been fortunate that my research has been in an academic environment in which I have been free to follow my shifting interests and those of my students, and I sympathise with present-day academic staff, who are more constrained to fit their research into perceived 'areas of Research Strength' and 'Priority Areas for Research', which change with shifts in Government science policy.

In accepting this award, I am keenly aware that the contributions of my many colleagues are also being acknowledged.

Arthur McComb

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