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SHALLOW LAKES

Obituary: Brian Moss (1943–2016)

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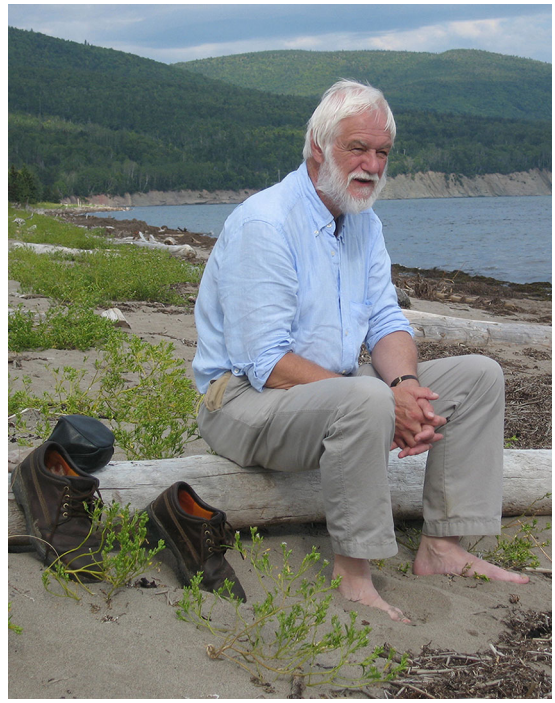
Emeritus Professor Brian Moss (B.Sc., Ph.D., D.Sc. F.I. Biol. C. Biol), University of Liverpool, UK died May 27, 2016 after a few months contending with liver cancer (see his letter in SIL news68, www.limnology.org/news). He is survived by his beloved wife, Joyce, and daughter, Angharad Simlett-Moss.

Brian (born July 6, 1943) obtained his Ph.D. degree at the University of Bristol where he worked on the algal ecology of two contrasting ponds under the supervision of Frank Round. Thereafter, he held a research post at Lake Chilwa in Malawi for a year where, with his wife, Joyce, he studied tropical limnology. This was followed by a stay in Michigan, USA, where he worked on a large-scale experimental lake system, investigating the role of carbon in phytoplankton ecology and the impacts of nutrients and fish predation on the structure of a deep, eutrophied lake. Looking for a job after work in the U.S., he was offered one as a research chemist in an illustrious multinational, but in the "nick of time" (as he described it, because he wanted to stay in academia), he secured a



Brian Moss in a relaxing moment after the SIL/ASLO conference in Montreal 2007 (photo J. Moss)

Erik Jeppesen and Penny J. Johnes coordinated this work as editors.

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lectureship at the School of Environmental Sciences at the University of East Anglia. There he carried out his world-renowned and highly influential research on the eutrophication problems of the Norfolk Broadland, a system of shallow lakes and rivers, and made a first attempt at maintaining the conservation value of such systems through restoration by biomanipulation. He battled with an alliance of the local water company and other vested interests over the role of phosphorus in the greening of the Broads, using field measurements and sizeable experiments to demonstrate the reality. Brian loved the Broads, and the ecological puzzles his research revealed—which he reflected upon in his New Naturalist book: *The Broads, the People's Wetland* (Harper Collins 2002). By that time, he had moved to the University of Liverpool, accepting in 1989 the Holbrook Gaskell Chair of Botany. His new playground included the Cheshire & Shropshire Meres, where he challenged the well-established paradigm of phosphorus being the dominant limiting nutrient in freshwaters and instead highlighted the importance of nitrogen-limitation in shallow lakes. He continued to run numerous experimental studies on the role of pH, nutrients, fish, salinity and climate in shallow lake ecosystems and train a new generation of Ph.D. students. In the Foreword to his seminal textbook *Ecology of Freshwaters: Man and Medium*, he cited as his early career influences, "Frank Round and Charles Sinker and that incredibly interesting group, including John Lund, Hilda Canter, Jack Talling, Geoffrey Fryer, John Mackereth and Winifred Pennington, who collectively established the reputation of the Freshwater Biological Association in the UK and internationally". He was also generous in acknowledging the importance of his colleagues, the many researchers he met on his international travels and when they visited him in the UK, and his numerous postdoctoral researchers and PhD students, as influences on his thinking over the years.

Brian has been one of the world's most influential lake ecologists during the past three decades. He detected several ecological patterns that later gave birth to some of the most cited ideas in the field of aquatic ecology and beyond. He was the inventor, mentor and inspiration behind modern ideas on shallow lake functioning. He was the first to identify the strong feed-back mechanisms and alternative states in shallow lakes; the first to show the role of macrophytes acting as a refuge for zooplankton against fish predation; the first to show the importance of high nitrogen loading for the loss of submerged plants—and thus for indirectly affecting the trophic dynamics in shallow lakes; the first to work on climate effects on the ecology of shallow lakes; and the first to study the role of salinity for trophic structure and dynamics in shallow brackish lakes. He always had a broad holistic approach and promoted the simultaneous realisation of different and complementary research approaches (e.g. field surveys, field experiments, lab experiments and theory). He promoted in situ experimental approaches by carrying out a series of mesocosm experiments, which included his novel work on experimental pond systems established at the University of Liverpool's Ness Botanic Gardens, in the North West of England in the late 1990s. This facility allowed him to assess how the function of ecosystems varied according to nutrient loading and climate change, and produced ground-breaking understanding of the role of multiple stressors as influences on aquatic ecosystems.

Brian conducted numerous in situ experiments at both local and European scales (photo T. Barker)

Brian published a high number of well-cited scientific papers (>300) and several books, including most recently *Liberation Ecology: The Reconciliation of Natural and Human Cultures* in the Excellence in Ecology Series (International Ecology Institute 2012), and *Lakes, Loughs and Lochs* (Collins New Naturalist 2015), following on from his earlier contribution—*The Broads*—to this series. Just before Christmas 2015, he finished a further book, *Ponds,* which will be published in the Naturalists Handbooks series, and which he intended would provide identification keys and suggestions for projects to amateur naturalists and students. His textbook *Ecology of Freshwaters* is now in its fifth edition; he worked intensively on the revision right up to his death, aware of the limited time available, and we know he was very happy with the outcome.

Brian assumed many highly responsible posts in order to promote and guide science and has in this capacity been president of the British Phycological Society, vice president of the British Ecological Society and vice president and president (two periods) of the International Society for Limnology (SIL). He was a long-serving editor of the Journal of Ecology and served as subject-matter-editor for several other leading journals. He received many prestigious national and international awards for his work, including the International Association of Limnology's Naumann-Thienemann Medal in 2007, the highest international honour for scientific limnology, for his research and leadership in creating new understanding of shallow lake function. In 2009, he was awarded the International Institute of Ecology Prize for excellence in limnetic ecology, the outcome of which was his book on *Liberation Ecology,* which went on to win the British Ecological Society/Marsh Christian Trust prize for the most influential book on Ecology published in the last 2 years at INTECOL in London in 2013. In 2010, the Institute for Ecology and Environmental Management awarded him its annual medal in recognition of his distinguished lifelong contribution to the theory and practice of limnology.

Brian was gifted in drawing the attention of scientists, managers and the general public to the impact of human activities on the health of freshwaters, including the loss of biodiversity resulting from both nutrient enrichment of waters and climate change. He often quoted from the work of Aldo Leopold, reminding us that the story of environmental damage through thoughtless human endeavour had been known of, and understood, by earlier generations, and that we continue to ignore this at the risk of our own future. A favourite quote was this: "There are some that can live without wild things and some that cannot". Brian was firmly in the latter group and persuaded many people to join him there. He strongly advocated the need for a holistic approach to the management of waters from source to sea. In one of his most recent presentations, at the Wetland Futures conference in October 2015, Brian argued strongly that all things are connected, and that a solution to the rising tide of problems in aquatic ecosystems would be found only if we start to view and manage waterbodies and landscapes as connected systems. In speaking to an audience comprising conservation organisations, charities and government agencies, Brian again quoted Leopold, saying "The most dangerous worldview is the worldview of those who have not viewed the world". He went on to tell the audience:

"If there is a discontinuity in the operation of policy concerning the connections between freshwaters and the ocean…. it is not for want of evidence that these connections exist, where they have not been disrupted by human exploitation…. We do not appreciate these connections, because in Europe we have disrupted continuity through 5000 years of clearance and enclosure, drainage and damming, pollution and manipulation…. We attempt to manage the unmanageable in tiny nature reserves that have lost most of their fundamental structure and features. Our response is a limited gardening and zoo-keeping that is laudable but harmless, inoffensive, uncontroversial, and diversionary".

He ended his presentation with a reminder that solutions to global environmental problems require us to be courageous in confronting the reality of these problems and the scale of the challenge we face in bringing these under control. He said, "Isolated tweaking of policies will not work…. What stops us is lack of courage and our biological nature as an invasive species". His plea was for a connected approach, and his final slide included a salient quote from W.H. Auden: "We would rather be ruined than changed. We would rather die in our dread than climb the cross of the moment and let our illusions die". As always, he was endlessly entertaining and thoroughly thought-provoking, challenging the status quo and rejecting complacency and indifference in the face of global environmental change.

Both the breadth and depth of Brian's understanding of ecosystems were impressive and so was his generosity in scientific endeavour. He was interested in developing and testing ideas, mentoring his students and research staff, and developing limnology in the less-developed world. He happily shared his knowledge while helping to develop a rigorous, yet wide, perception of the ecological processes. Despite being busier than many academics, Brian always found the time to discuss ideas with all students, particularly with those coming from developing countries and with limited opportunities. He was always very generous in his support of students, even long after they had finished their theses. Many of us have received his generous help in writing our first papers, accompanied by a typical Moss quip, "I will be happy to help making it a thing of beauty and joy forever", inspired by John Keats' poem, *Endymion*. At the same time, he would advise us to "always shoot at the stars, just don't forget gravity" when asked about which scientific journal was the right one to submit our draft articles to; warm advice some of us transmit to our own students now.

Brian continued to do plankton and periphyton counting early in the morning throughout his career (photo T. Barker)

During undergraduate teaching, Brian used arts and literature to entice students to engage on a deeper level. On field trips, he would sit his freshwater ecology class on a reed-covered riverbank in Broadland and instruct them to look across the endless landscape, while he read Betjeman poems to them. The poems were printed on the class handouts, next to the identification keys for water bugs and ecological models. The rest of the day would be spent taking peat cores, analysing water chemistry, or debating an environmental management problem. Brian's understanding of teaching came about, because he was never tired of learning himself. As Head of School in Liverpool, he put aside an hour each day to count algae at the microscope from an experiment being conducted in the lab by his students. He did it because he wanted to stay hands-on. He loved drawing figures for manuscripts when pondering the results. He was an early riser, and many of his papers were written in the hours before he came into work, a practice he used to recommend to his rather more bleary-eyed PhD students. When he moved to Liverpool, he continued to work on the Norfolk Broads as well as setting up new research sites. This led to many long trips from Liverpool to Norfolk to meet up with the large group of researchers there. Alas, his renowned ability to work in the early morning was offset against the need for him to take a break in the afternoon, and his postdocs fondly remember him driving from Liverpool over the Pennines, then handing over to the postdoc to drive the rest of the way across the flat lands of The Wash, while he snoozed in the passenger seat. He and his staff and students soon found a happy compromise, conducting most of their academic meetings in the middle of the day when all were fully alert. He certainly set the standard as a role model and mentor and many of his research staff and students have gone on to pursue a career in ecology, limnology, catchment management and as wildlife defenders in several regions of the world. All are proud to be a part of the 'Moss family'.

Brian's passion for getting students on the water sometimes led to him overlooking the more practical elements of boatmanship. Preventing toppling out of rickety "research vessels" (read 'decaying rowing boats handed down from some local conservation agency') was part of field preparations. During a memorable undergraduate field trip to Slapton Ley in the west of England, Brian enthusiastically encouraged the students to get involved in setting up bottles for diel oxygen measurements, but overlooked the fact that the drain plug for the concrete boat had been left high and dry on the bank. Brian and his boatload of students rowing furiously into the lake were horrified to see a spectacular spout of water emanating from the centre of the hull.

On another occasion he was keen to show an eminent colleague from Australia around Cockshoot Broad, where seedlings had been planted in an attempt to reinstate the macrophyte community and so provide the necessary refugia for the zooplankton community. The results after the first year had been eagerly anticipated: had the plants managed to survive the greedy coot population? Two boats were rowed around the lake scanning the bed of the lake for shoots, with the postdocs, showing great pre-science, in one boat and Brian with the eminent visitor in another. Suddenly, as a sprig of green was spotted, a shout went up and Brian and the eminent visitor rushed to look over the side of their boat: they only just escaped a very close encounter with that plant as the boat tipped wildly onto its side. We also remember Brian stepping backwards off a boardwalk and having to be hauled out of the nearby reedbed; him having to cling on to a corer while coring Hoveton Great Broad, Norfolk as, in his distraction, the boat he was using had drifted away; and his fondness for including hippopotami in lectures, directing a full auditorium of students in a rendition of *The Hippopotamus Song* by Flanders & Swann. He was always able to see the lighter side of life, and told us all with much merriment the tale of him falling off the stage while speaking at a EUROLIMPACS workshop in Innsbruck, but continuing with a ragged trouser leg and blood tricking out of his knee, with a familiar, self-admonished "Oh bugger". These events reflected Brian's focus to the task in hand, and working with him was never dull.

Brian put a lot of effort into promoting international cooperation and led several multinational research projects. He was the manager of two very comprehensive European projects on shallow lakes (SWALE, ECOFRAME), treating, respectively, the role of fish and nutrients in shallow lakes along a climate gradient and the ecological state of lakes in relation to the European Water Framework Directive. Additionally, he was work package leader (climate and eutrophication in rivers, lakes and wetlands) of the EU project EUROLIMPACS, and of the BUFFER project, looking at the dynamic connections between lake nutrient status and phytoplankton production in the context of their catchments, with a focus on climate and freshwaters. In all these projects, Brian showed excellent leadership; he assumed the leading role when needed, but allowed the participants and groups involved a lot of freedom to grow individually. He lectured widely on freshwater issues all over the world and gave short courses in India, China, Turkey, Uruguay, New Guinea, Kenya, Tanzania, Uganda, South Africa and Malaysian Borneo.

Brian cared for science development internationally such as Africa (photo Tropical Biological Association)

Brian's work drew much critical acclaim—from scientists, environmental managers, and the general public. He was a superb communicator to all groups and a strong advocate of speaking and writing 'in plain English'. He had no time for abstruse phraseology, jargon or acronyms, considering these elitist and unhelpful in the communication of science ideas. He was a hugely popular plenary speaker at international conferences, drawing a large audience wherever he spoke. Brian combined art and science with a great deal of humour to communicate and engage with his audience. He held each audience in the palm of his hand, drawing them into an appreciation of the aquatic world and the pressures it faces. Brian's talks consistently, even after his retirement, attracted a considerable crowd and they were highly influential both

scientifically and emotionally. One such was the plenary lecture Brian gave at the SIL 98 congress in Dublin. Plenary lectures there were arranged so that two ran in parallel, and there was much debate amongst the delegates about who would go to which lecture. Brian pulled such a large crowd (over 3/4 of all of the delegates) that many of our most eminent colleagues had to sit on the floor in the vast conference hall, and were rolling in the aisles with laughter as he informed and entertained as only he could. He received a standing ovation from the 1000-strong audience.

Another memorable talk was the one he gave in Uruguay in 2012, when he stopped on his way to give a plenary talk in the Argentinean Limnology Congress. He used Wagner's The Ring of the Nibelung opera to illustrate the alternative states hypothesis and paralleled the clear and turbid states in shallow lakes and their buffer mechanisms with a future sustainable global model versus the modern unsustainable western model that leads to the destruction of nature and human wellbeing. He ended the talk with a passionate poem ("Some sort of ending", which he wrote in 2008) on the reaction of State powers to maintain the status quo via manipulation of markets, the use of those powers to suppress ecologists speaking out in defence of the environment or to highlight the scale of the problems resulting from ill-advised policy, and the hope of a fight-back given by committed activists denouncing the global crisis in global protests. Many in the audience of around 150 faculty members and students were moved to tears and everybody stood up for a very long ovation. This talk has been recalled by several of the Environmental Management undergraduate students attending as the most inspiring hour in their 4-year studies. One of his last international plenary talks—long after his retirement—was a fantastic, thought-provoking wrap-up talk at the end of the shallow lakes conference in Turkey in 2014; this was posted on YouTube because so many participants in the conference requested a recording of Brian's talk. In his last public talk, at a small wetland seminar—The Meres and Mosses Forum—in north-west England, March 2016, Brian, though physically weak, delivered a stunning and cutting edge lecture on the interconnectedness of ecosystems within the landscape, the importance of this to global sustainability, and the role of catchment-scale to international-scale policy and coordination in conservation efforts.

Brian's work didn't always receive universal approval. His attempts to restore a Victorian boating lake in mid-Wales, through removal of the huge numbers of carp that were stocked, saw him vilified in the angling press. This led to a new theory of Brian: that the size of carp displayed by the angler on the front cover of the magazines was inversely proportional to the size of their rod. In his inspired article that summarised the whole episode, "The lake at Llandrindod Wells—a restoration comedy?", Brian was again one of the first to recognise that scientific evidence alone is not sufficient to deliver a better environment; restoration ecologists need to be involved in the whole process, working with the whole community from the very start to enable understanding and enlist its support.

Brian cared for science—not for the H index, impact factors of journals and the wealth of time-consuming irrelevant bureaucratic issues that scientists have to deal with nowadays. He valued the skills of the ecologist above any inaccessible algorithm that was purported to calculate the state of a waterbody without any insight into its function. At the end of the influential ECOFRAME paper on classification of shallow lakes, Brian wrote: "During the workshop discussions of this project, one of us remarked that from a single visit to a lake, an overview of its catchment, knowledge of its pH and Secchi disc transparency, and a brief examination of its macrophytes, an experienced limnologist could easily distinguish high/good from moderate from poor/bad status. It is the tragedy of our time, perhaps of all times, that we must set up expensive and elaborate measures to do what, with experience, and consensus within society as to its environmental goals, could be done much more easily".

When he approached his retirement, Brian decided to write poems about bureaucracy and bureaucrats at the bottom of his e-mail replies to officialdom, knowing all too well that they very often read them, as they requested more and more information from him. The poems became longer and more hardhitting, the closer he came to retirement, when he would be finally out of reach of the bureaucrats' meddling.

In a talk in Leicester in 1995, he famously linked a slide of two rutting stags with the internecine politics of government agencies, and to an audience of the UK environmental agency staff, he demonstrated well researched, as ever, the lack of experience of the agency's board in matters environmental. He frequently returned to this theme, believing firmly that policy should be informed by a sound understanding of the science and certainly not manipulated to suit a political end. At the Wetland Futures conference in 2015, he pointed out that, of the 196 then-current world leaders, not one of them had a science background. Brian felt this was a damning indictment of the current situation and one deserving of remedy. As he said "By taking cognisance of the fundamentals [of the science], no matter what inconvenient truths they may embrace, we can turn from being the most aggressive invasive species that evolution has ever produced, to a constructive cog in an eternal machine". Yet, his jibes at authority usually raised more of a smile than a frown.

Besides being a strong scientist, Brian was also a skilled double bass player in the Southport Orchestra, Southport. Here performing at the SIL/ASLO meeting in Montreal in 2007 (Photo Jean-Pierre Descy)

Brian's impressive pen is no longer active and his clever and wise voice is silent, but his wisdom, ideas and exemplary behaviour as a human being will be with the undersigned and the other people who had the good fortune to meet him and work with him, as long as we and they live and as long as his poems, articles and books are read and revisited. More importantly, his truly pioneering work on the dynamics of shallow lakes will last forever. One of the strongest and wisest limnologists this globe has ever fostered is now back in the C–N–P cycle (more or less his own words, SILnews68), and he will be truly missed—not only by the "Shallow Lakers", who lost their true mentor and thus, became more "shallow", but by the limnology and ecology societies at large. We were privileged to work with him. He was an inspirational leader and a great friend.

With the very deepest respect

On behalf of the Shallow Lakers and Brian Moss' large scientific family and their many offspring: Tom Barker, Meryem Beklioğlu, Laurence Carvalho, Jane Fisher, Lars-Anders Hansson, Haseeb Irfanullah, Kenneth Irvine, Cassie James, Erik Jeppesen, Penny Johnes, John Iwan Jones, Zhengwen Liu, Nestor Mazzeo, Suzanne McGowan, Mariana Meerhoff, Tiina and Peeter Noges, Geoff Phillips, Julia Stansfield, Martin Søndergaard and Adrian E. Williams.