

Georgina Mace (1953–2020)

Pioneering conservation biologist and sustainability scientist

By **Andy Purvis**^{1,2} and **Kate E. Jones**^{3,4}

Georgina Mace, who died on 19 September at the age of 67, did groundbreaking research assessing the state of biodiversity, how human actions have driven biodiversity loss, and how society might change to deliver a sustainable future. Intellectually fearless and possessing absolute integrity, Georgina selflessly supported and empowered countless researchers. One of the first conservation biologists and a pioneer for uniting disciplines to deliver evidence-based change, she provided the insights that underpin conservation laws and policies worldwide.

Georgina was born in Lewisham, London, in 1953. Her early fascination with biology led to a B.Sc. in zoology from the University of Liverpool in 1976 and then a Ph.D. from the University of Sussex on mammalian evolutionary ecology in 1979. Georgina joined the Zoological Society of London (ZSL) in the mid-1980s, where she used her quantitative skills to explore the genetic and ecological processes that can drive small populations extinct. This led to a remarkable career trajectory, in which she always tackled the next obstacle on the critical path toward better nature conservation, immersing herself in whatever field was necessary to do so.

The first step was her work on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species. Recognizing the list's importance, Georgina—against advice—accepted the challenge of making it more useful for conservation. At the time, some listings reflected force of personality more than weight of evidence. By analyzing population ecological models, she and modeler Russell Lande derived five quantitative criteria that could be applied transparently and repeatably to any species to assess its risk of extinction. In piloting these revolutionary criteria through the approval process, Georgina's characteristically respectful, patient, logical, and focused arguments convinced the skeptics, bringing a rigor to Red List assessments that provided a

robust basis to the legal protection of species. This enabled comprehensive assessments of all species across major taxonomic groups and led to analyses of which features of species' ecology and life history made them more susceptible to human impacts and which threats posed the greatest risk.

The first comprehensive Red List assessments found that 12% of birds and 24% of mammals were threatened with extinction, prompting the global signatories to the United Nations (UN) Convention on Biological Diversity (CBD) in 2002 to commit to substantially reducing the rate of biodiversity loss by 2010. To determine what the rate of biodiversity loss was, Georgina led the bio-



diversity component of the UN's Millennium Ecosystem Assessment in 2005, which marshaled all available evidence to show the rate and severity of ecosystem degradation. Georgina went on to influence the design of many of the science-based indicators of the global status and trends of biodiversity used to track progress toward internationally agreed-upon targets; she also helped to set up ZSL's Indicators and Assessments Unit in 2006 as a hub for such work.

The world failed to meet the CBD 2010 target. Realizing that nature being undervalued was a major problem, Georgina increasingly transcended disciplinary and science-policy boundaries. Her work on the unprecedented U.K. National Ecosystem Assessment (2009–2011) established a “natural capital” framework for decision-making, which viewed the state of nature as an asset. This and the 2010 Lawton Report (“Making Space for Nature”), on which she also worked, started a snowball effect on U.K. policy as the government explicitly acknowledged that addressing the de-

cline in nature was first and foremost an economic problem with consequences for health and well-being. A 2011 Natural Environment White Paper made an astonishing key commitment not just to halt the decline in nature but to reverse the trends of the past century. The Natural Capital Committee (NCC)—the first organization of its kind, directly advising the U.K. government—was established in 2012 with Georgina as a founding member. On the NCC's recommendation, an innovative national 25 Year Environment Plan was published in 2018. The same principles underpin the Agriculture and Environment Bills currently under consideration by Parliament.

Our first collaborations with Georgina were so fascinating, so inspiring, and so enjoyable (she had a mischievous sense of humor) that we soon became hooked on the same challenges that absorbed her. We started working with her around the time when, in 2000, she became ZSL's director of science and head of its Institute of Zoology. She was an inspirational and transformative leader and role model. She demonstrated and encouraged crystal-clear strategic thinking, she listened to and supported everyone equally, and she never dominated the discussion or raised her voice (although keen observers could spot a raised eyebrow).

Despite Georgina's aversion to the limelight, she received countless awards, honors, and appointments. She was elected as a fellow of the Royal Society in 2002, won Japan's International Cosmos Prize in 2007, became the first female president of the British Ecological Society in 2011, and was made a Dame Commander of the Order of the British Empire in 2015 (but those who called her Dame Commander did so at their peril). After 23 years at ZSL, she moved to Imperial College London in 2006 to lead the Centre for Population Biology and then set up her own institute, the Centre for Biodiversity and Environment Research, at University College London in 2012. She stepped down as director in 2018 to concentrate on research and policy but still made time for everyone who needed her support and advice.

Georgina continued working until a few days before her death. Among her 2020 research papers are an analysis showing that it may not be too late to bend the curve of biodiversity and restore some of what has been lost and a framework to ensure that decisions about using nature do not shortchange future generations. As the links between how we use nature and the current pandemic become clearer, the momentum from world leaders to address biodiversity loss is growing. Georgina has left as her legacy the tools we need to coexist with nature. ■

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