Obituary

Georgina Mace
(1953–2020)

Pioneer of biodiversity accounting who overhauled the Red List of threatened species.

Georgina Mace shaped two cornerstones of modern ecology and conservation. One was the global inventory of species threatened with extinction, the International Union for Conservation of Nature (IUCN) Red List. The second was the United Nations Millennium Ecosystem Assessment. One of the sharpest minds of her generation, she strove to document and stem biodiversity loss with analytical rigour and multidisciplinary approaches. She died on 19 September, aged 67.

Throughout her career, Mace developed tools for evidence-based policymaking. Before her, the Red List was based on nominations from experts rather than data, undermining confidence in its accuracy. She devised criteria to standardize assessments. The Red List is now the most used and trusted source for assessing trends in global biodiversity.

Mace was born in London in 1953. She studied zoology at the University of Liverpool, UK, before doing a PhD in the 1970s at the University of Sussex in Brighton, UK, where John Maynard Smith was pioneering mathematical approaches to evolutionary ecology. As a postdoc at the Smithsonian Institution in Washington DC, she studied the impacts of inbreeding on captive animals.

In 1983, she joined the Institute of Zoology, the research arm of the Zoological Society of London, where she remained for 23 years, latterly as director from 2000 to 2006. There, Mace continued to work on the genetic management of zoological collections and small populations. Her findings informed the conservation status of several species, including the western lowland gorilla (*Gorilla gorilla gorilla*), and highlighted the value of reproductive technology in managing captive populations of endangered species, such as the Arabian oryx (*Oryx leucoryx*) and Przewalski's horse (*Equus przewalskii*). She became increasingly interested in population viability, extinction risk and setting conservation priorities.

In 1991, this led her, together with US population biologist Russell Lande, to question the IUCN categories of threats and the associated nomination process as being largely subjective. They suggested three categories: critical, endangered and vulnerable. These they defined in terms of the probability of a species becoming extinct within a specific period, such as five years or two generations. They drew up standardized criteria based on

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population-biology theory. These included, for example, total effective population size, the population trend over the past five years and observed or projected habitat loss. Mace later introduced, among other things, categories for species that are not currently under threat. This work ultimately defined the categories that the IUCN uses now.

In 2006, Mace became director of the NERC Centre for Population Biology at Imperial College London. There, she worked on the definition of biodiversity targets and assessing species' vulnerability to climate change. She also studied the link between biodiversity and ecosystem services – the benefits that humans draw from nature, such as carbon sequestration, medicines or waste decomposition.

> **"She excelled in building consensus, a key step towards evidence-based policy."**

From 2012, as founding director of the Centre for Biodiversity and Environment Research at University College London, she developed an interest in natural-capital accounting, the process of calculating the total stocks and flows of natural resources and services in an ecosystem or region. Her blending of economics and ecological theory to define a risk register for natural capital helped to provide an effective focus for monitoring and data gathering. It also contributed to a common understanding of priorities across fields.

Mace bridged the gaps between genetics, population ecology and macroecology, sub-disciplines in which she regularly supervised students, networked and published. She also demonstrated the importance of conservationists engaging with researchers in other disciplines, such as climate science, economics and social science. She excelled in building consensus, a key step towards evidence-based policy.

Mace was coordinating lead author for biodiversity on the Millennium Ecosystem Assessment, launched in 2001, which demonstrated that rapidly growing demand for food, fresh water, timber, fibre and fuel resulted in a large and largely irreversible loss in biodiversity. She supported the development of assessments for the biodiversity target of the UN Convention on Biological Diversity in 2010 and, most recently, acted as review editor for the Global Assessment of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. She held similarly pivotal roles at the national level, on UK climate and environmental assessments.

She broke several glass ceilings. Mace was the first president of the international Society for Conservation Biology from outside North America, and the first female president of the British Ecological Society. Her many awards and honours included a fellowship of the Royal Society and, in 2016, she was made a dame.

Georgina was a role model: firm but fair, collaborative, reliable, unassuming, approachable – the kind of critical friend we all need. She supported the career progression of numerous ecologists and influenced many more. She'd nominate you for a post even when you didn't think she had noticed your work; she'd make a witty remark in the middle of a heated discussion. Few knew that she had cancer. Never one to make a fuss about herself, nine days before she died, she published a paper on habitat conversion and biodiversity loss (D. Leclère *et al. Nature* **585**, 551–556; 2020). Her death leaves a void: she will be sorely missed.

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