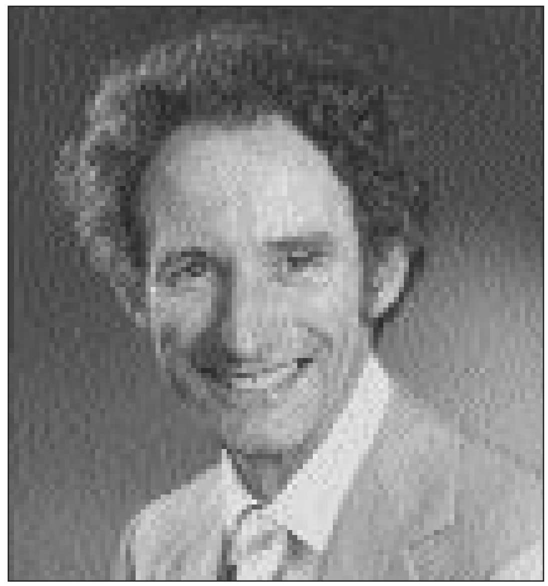
Robert May Receives Crafoord Prize

Simon A. Levin



Robert McCredie May

Of all the areas of application of mathematics to biology, ecology has by far the longest and richest history. Through the efforts of Alfred Lotka and Vito Volterra, a framework was introduced nearly a century ago for the consideration of the dynamics of interacting species, and many thousands of papers have been inspired by those seminal works. But whereas the master, Volterra, already a distinguished mathematician, was inspired by data—the fluctuations of the Adriatic fisheries—while producing innovative mathematics, too many of the papers that followed were totally divorced from data and were sterile exercises in mathematics with little to contribute to either discipline. In the half century that followed Volterra's work, the discipline had stagnated, and it is difficult to point to any major contributions over that very long period of time.

The situation is dramatically different today. Mathematical ecology is a vibrant and exciting area of research, with strong ties to data and with deep mathematical content, and one of the major figures in effecting that transformation is Sir Robert May, winner of the 1996 Crafoord Prize. May's contributions are stunning in their depth and quantity, and he has influenced the development of the entire subject of ecology fundamentally while making profound contributions to mathematics; the latter influences were recognized in his selection to give the AMS's Gibbs Lecture in 1994. Mathematical ecology thrives today because it has become a part of the subject of ecology rather than a commentary on it. Many have contributed to that metamorphosis, but none has had greater influence than Robert May, who has led by example in demonstrating that mathematical ecology must be a science, seeking patterns in data and being challenged constantly by observations.

May began his career as an astrophysicist and plasma physicist; that he later became president of the British Ecological Society and is today Chief Scientist of Great Britain is testimony to his commitment to the scientific challenges of his adopted discipline. Indeed, May had become quite a distinguished physicist by the age of thirty-three, holding a "Personal Chair" at Sydney University. There, influenced by the eminent Australian ecologist L. C. Birch, May became fascinated with the problems of the biological world. He traveled to Princeton to spend a leave at the Institute of Advanced Study in 1972, where he began a happy fellowship and eventual collaboration with Robert MacArthur, the leading theorist among ecologists in the world at that time. From that interaction emerged May's first major contribution to ecology, his exploration of the relationship between complexity and stability in ecological systems. It was taken for granted among many ecologists of the day that more diverse systems were necessarily more stable. May, through a brilliant series of investigations of models of systems of differing com-

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About the Prize

The Royal Swedish Academy of Sciences has announced that its 1996 Crafoord Prize in the biosciences, with particular emphasis on ecology, has been awarded to Sir Robert M. May of Oxford University. May was cited "for his pioneering ecological research concerning theoretical analysis of the dynamics of populations, communities and ecosystems." The Crafoord Prize, which carries a value of $500,000, will be presented at the Academy in Stockholm on September 19, 1996.

Previous winners of the Crafoord Prize include Louis Nirenberg of the Courant Institute of Mathematical Sciences, who received the prize in 1982. Pierre Deligne of the Institute for Advanced Study and Alexandre Grothendieck of the University of Montpellier in France shared the prize in 1988; in a highly publicized episode, Grothendieck turned down his half of the prize. In 1994 the Crafoord Prize was awarded jointly to Simon K. Donaldson of Oxford University and S.-T. Yau of Harvard University.

Holger Crafoord, a Swedish industrialist who made his fortune in pulp and paper products and in artificial kidneys, established the Holger and Anna-Greta Crafoord Prizes for basic research in several fields not covered by the Nobel Prizes: mathematics, astronomy, the geosciences, and the biosciences. Each year the Academy designates an area within the field being honored that year and chooses one or more prizewinners who have been influential in that area.

—*Allyn Jackson*

plexity, showed that the issue was much more complex than had been realized, destabilizing the prevailing dogma. Work with MacArthur on the limits to how many species could be packed into systems over evolutionary and ecological time complemented this work and led to his influential *Princeton Monograph on Complexity and Stability* in 1974. Upon Robert MacArthur's untimely death in 1973, May was selected to replace him as professor of zoology at Princeton; he later (in 1984) won the award established by the Ecological Society of America to honor MacArthur's name.

At Princeton, May continued his fundamental contributions to ecology with a long series of papers, but undoubtedly, his most influential contribution to science in this period was his recognition of the ubiquity of chaotic dynamics in the most commonly used nonlinear models for population growth. Although similar ideas were being explored in other disciplines, May's investigation of the behavior of one-dimensional maps became one of the few places in biology where theoretical research found its way back into the core of mathematics to influence the development of the subject. Lorenz had published his observations on weather models a few years before, Ruelle and Takens had presented their ideas on turbulence, and Gollub and Swinney had performed their critical experiments. This led Jim Yorke to coin the term chaos and to publish his analyses at virtually the same time that May was investigating similar behavior in population models. Bob May and I gave lectures back-to-back at Maryland in 1974, where May presented his findings. Jim Yorke, who had invited us both to speak, leaped to his feet excitedly to point out the similarity of the two pieces of work and to add some insights of his own. I believe that this was the first point of contact they had on this topic and that it was a milestone in blending the separate trains of research. May's research accomplishments are so many that space does not permit me to catalogue them, but I would be remiss if I ignored his profound influence on the study of infectious diseases. Shortly after his success with chaos, May began his most successful collaboration, with the British parasitologist Roy Anderson. Anderson, equally remarkable in his own right, also came from a strong background in quantitative methods, and the partnership could hardly have been more complementary at either a personal or a professional level. Anderson and May rewrote the subject of mathematical epidemiology, which also had a long and impressive history. In their hands, epidemiology and ecology became inseparable, and their work has had profound influence among both mathematicians and practitioners, deeply influencing thinking and practice regarding such fundamental issues as vaccination strategies for infectious diseases and the interactions between HIV and the immune system.

May's contributions and influence continue unabated, even as he has taken on heavy administrative responsibilities in the most important scientific position in Britain. He left Princeton for Oxford in 1988 (to my gain, given the vacancy thereby created here), but remains a Visiting Professor at Princeton. The roots he developed there have surely helped to shape his career, just as he helped to shape biology at Princeton. His great interest in biodiversity found fertile soil in New Jersey and led to his involvement with efforts associated with the dramatic losses of the biodiversity of the planet. He has been on advisory councils and boards for the World Wildlife Fund, the International Whaling Commission, the Marine Mammals Commission, the Society for Conservation Biology, and trustee of the World Wide Fund for Nature, the Royal Botanic Gardens, and the Natural History Museum. In recent years he has also made fundamental contributions to the science of conservation biology, winning the inaugural Marsh Prize for Conservation Science in 1992.

Sir Robert May has had a deep influence on the maturation of ecology as a science and on the ecology of science. It is a tribute both to his own contributions and to the subject that he helped transform that he is the recipient of the Crafoord Prize for 1996.