IMPERIAL

Georgina Mace Centre for the Living Planet

Annual Report 2025

Professor Vincent Savolainen

Imperial College London

imperial.ac.uk/georgina-mace-living-planet

Foreword

Imperial's Georgina Mace Centre for the Living Planet at Silwood Park tackles urgent global environmental challenges, honouring the late Professor Dame Georgina Mace FRS, a former colleague whose pioneering work on the IUCN Red List criteria has shaped global biodiversity commitments.

This year has been particularly busy, and below are just a few highlights.

In March, Jack Rankin MP, Member of Parliament for Windsor, visited Imperial's Silwood Park Campus to learn about our work in ecology, evolution and conservation. He commented:

"I had such an insightful visit to Imperial College London's fantastic Silwood Park campus. Here I saw first-hand their incredible, world-leading research into some of the most critical scientific sectors, such as ecology, evolution and conservation. As a maths and physics graduate, I am a keen supporter of encouraging our next generation into STEM careers. Seeing this research into science-based solutions to tackle some of the world's greatest environmental challenges head-on, as I did during my visit, will inspire many to join them in their world-class research."

Controlled-environment insectarium illuminated with red light, which most insects cannot perceive.

Jack's visit was particularly fruitful, as he helped us prepare for a biodiversity debate to be held at the Houses of Parliament on 29 June 2026. The debate, themed *"Can AI Save Planet Earth?"*, will bring together key stakeholders including policymakers, researchers and partners to discuss this pressing issue, alongside robotic and AI exhibits focused on environmental science and biodiversity.

In November, philanthropic support from the Michael Uren Foundation marked a major milestone for ecological research at Silwood Park Campus, with an £11.34 million gift set to propel advances in environmental science. The new Sir Michael Uren Future Environments Facility will significantly expand both the scale and speed of research at Silwood. The facility will allow Imperial scientists to recreate specific environments and collect high-quality data on how plants and insects behave in their natural

Jack Rankin, MP for Windsor, visits Silwood's labs.

Workshop organised by CABI, now based at Silwood Park, on sustainable agriculture in Ghana. Photo: V. Savolainen.

Silwood Sustainability Champions and Leif the Mascot at Bugs, Birds & Beasts Day 2025.

habitats and respond to different climate conditions. Researchers will be able to manipulate temperature, humidity, lighting and atmospheric gases to simulate a wide range of environments, including drought-stricken landscapes and high-CO_2 atmospheres. As each room can be independently controlled, multiple scenarios can be tested simultaneously at a scale that would be impossible in a conventional laboratory incubator, positioning Silwood at the forefront of experimental environmental research.

We are also delighted to report that the Centre has earned a Bronze Green Impact Award this year. This achievement reflects the dedication and creativity of our Sustainability Champions. Green Impact is an international, UN award-winning programme run by SOS-UK and aligned with Imperial's Sustainability Strategy 2021–2026. It supports staff and students in making measurable improvements across areas such as energy use, waste reduction, biodiversity and sustainable travel. Achieving a Bronze Award represents important first steps towards embedding sustainable practices into everyday operations, and we thank everyone involved for their commitment to driving positive environmental change.

Finally, co-director Professor Vincent Savolainen organised two workshops aligned with the aims of the Centre. With support from the Research England International Science Partnerships Fund, 17 delegates from the UK, Côte d'Ivoire and Ghana met in February in Ghana, hosted by Silwood's partner CABI, to discuss resilient coconut breeding for food security in West Africa. In September, scientists from the UK, USA, Canada, and France convened at the Oak Spring Garden Foundation in the USA to discuss how best to infer and study global patterns of plant dispersal and distribution, and how these may be altered under global change. The meeting was hosted and funded by the Foundation, strengthening international collaboration on plant biodiversity research.

Through these activities, we are contributing to the goals of Imperial's new School of Convergence Science, which takes a radically new, mission-driven approach to addressing the challenges that will shape our future. In particular, we align closely with the School of Sustainability, which exists to accelerate solutions and envision a world where people can live prosperous, meaningful lives in harmony with the planet. By building the necessary evidence, coalitions and capabilities, we are working to help make that vision a reality.

Professor Vincent Savolainen
Director

Professor Matthew Fisher
Co-Director

Key indicators

£97.58 M
of external grant income*

51 PhD students
based at Silwood Park**

68 Masters students
based at Silwood Park from 15 countries

483 peer-reviewed scientific publications,
of which over 40 were in leading *Nature* and *Science* journals***

14 Outreach Events**

14 Field experiments
based at Silwood Park*****

*This is the full list of grants won by Silwood Park's Life Sciences staff ending after 1 January 2025 and including subcontracts.

** PhD Students enrolled through 2030.

*** Nature, Nature Climate Change, Nature Communications, Nature Ecology & Evolution, Nature Food, Nature Medicine, Nature Metabolism, Nature Microbiology, Nature Reviews Earth & Environment, Nature Reviews Microbiology, Science, and Science Advances.

**** Biology field practicals, Scouts pond dipping, work experience students, Bournemouth undergraduates visit, White City public engagement event.

***** Uren Green Microbiome, long-term monitoring, undergraduate group project, master field projects, teaching field practicals.

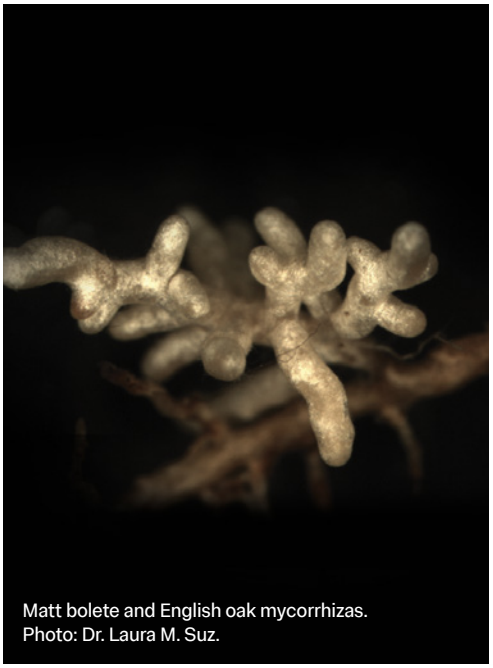
Research highlights

Fungal impacts on Earth's ecosystems

Over the past billion years, the fungal kingdom has diversified to more than two million species, with over 95% still undescribed. Beyond the well-known macroscopic mushrooms and microscopic yeast, fungi are heterotrophs that feed on almost any organic carbon, recycling nutrients through the decay of dead plants and animals and sequestering carbon into Earth's ecosystems. Human-directed applications of fungi extend from leavened bread, alcoholic beverages and biofuels to pharmaceuticals, including antibiotics and psychoactive compounds. Conversely, fungal infections pose risks to ecosystems ranging from crops to wildlife to humans; these risks are driven, in part, by human and animal movement, and might be accelerating with climate change. Genomic surveys are expanding our knowledge of the true biodiversity of the fungal kingdom, and genome-editing tools make it possible to imagine harnessing these organisms to fuel the bioeconomy. Here, Professor Fisher and 32 co-authors examine the fungal threats facing civilization and investigate opportunities to use fungi to combat these threats.

***Nature* 638:49 (2025)**

Sampling amphibian dieoffs caused by the emerging fungal infection – chytridiomycosis – in the French Pyrenees. Photo: Dirk Schmeller.



Matt bolete and English oak mycorrhizas.
Photo: Dr. Laura M. Suz.

Nature Returns: Harnessing Mycorrhizal Fungi for Climate Resilience and Carbon Capture

The Nature Returns programme pilots Nature-based Solutions for climate change at the landscape scale, restoring over 800 hectares of habitat, planting 95,000 trees, and engaging communities across England. Research by Professor Bidartondo and 22 co-authors from Natural England, Kew Gardens, and other organisations revealed that mycorrhizal fungi are crucial mediators of soil carbon storage, with fungal communities strongly correlating with carbon stocks and some species serving as indicators of soil carbon. These symbiotic fungi enhance long-term carbon sequestration and soil health across restored grasslands and woodlands. The programme also developed new tools for measuring carbon in vegetation and soil, including non-destructive biomass methods and the LIMMMA land-use model. Partnerships with the Environment Agency and Forestry Commission advanced green finance models to sustain Nature-based Solutions. Nature Returns demonstrates that investing in nature, particularly through mycorrhizal-driven soil systems, supports Net Zero, biodiversity recovery, and resilient landscapes essential for climate adaptation.

***Nature Returns' Final Report, Natural England,* JP064 (2025).**

An African perspective to biodiversity conservation in the twenty-first century

Africa boasts high biodiversity while also being home to some of the largest and fastest-growing human populations. Although the current environmental footprint of Africa is low compared to other continents, the population of Africa is estimated at around 1.5 billion inhabitants, representing nearly 18% of the world's total population. Consequently, Africa's rich biodiversity is under threat, yet only 19% of the landscape and 17% of the seascape are under any form of protection. To effectively address this issue and align with the Convention on Biological Diversity's ambitious '30 by 30' goal, which seeks to protect 30% of the world's land and oceans by 2030, substantial funding and conservation measures are urgently required. In response to this critical challenge, Professor Savolainen (Imperial), Dr Bezeng Simmy (Royal Society for the Protection of Birds UK) and another 25 scientists and conservationists working in Africa proposed five recommendations for future directions aimed at enhancing biodiversity conservation for the betterment of African society: (i) accelerate data collection, data sharing and analytics for informed policy and decision-making; (ii) innovate education and capacity building for future generations; (iii) enhance and expand protected areas, ecological networks and foundational legal frameworks; (iv) unlock creative funding channels for cutting-edge conservation initiatives; and (v) integrate indigenous and local knowledge into forward-thinking conservation strategies. By implementing these recommendations, they believe Africa can make significant strides towards preserving its unique biodiversity, while fostering a healthier society, and contributing to global conservation efforts. This paper follows the successful scientific discussion meeting organised at the Royal Society on 12–13 June 2023, titled "Bending the curve towards nature recovery: Building on Georgina Mace's legacy for a biodiverse future."

***Phil. Trans. R. Soc. B* 380:20230443 (2025)**

Africa has lost several iconic species to extinction, largely due to overhunting, including the Atlas bear, North African elephant, blue antelope, quagga, and Cape lion. However, hunting, including trophy hunting, is not always harmful and can, in some contexts, support biodiversity conservation.
Image: D. Maizels.

Passive acoustic monitoring through acoustic devices are an emerging tool to sample biodiversity. Photo: Professor Cris Banks-Leite.

Opportunities and challenges for monitoring terrestrial biodiversity in the robotics age

With biodiversity loss escalating globally, a step change is needed in our capacity to accurately monitor species populations across ecosystems. Robotic and autonomous systems (RAS) offer technological solutions that may substantially advance terrestrial biodiversity monitoring, but this potential is yet to be considered systematically. Professor Banks-Leite and 24 co-authors used a modified Delphi technique to synthesise knowledge from 98 biodiversity experts and 31 RAS experts, who identified the major methodological barriers that currently hinder monitoring, and explored the opportunities and challenges that RAS offer in overcoming these barriers. Biodiversity experts identified four barrier categories: site access, species and individual identification, data handling and storage, and power and network availability. Robotics experts highlighted technologies that could overcome these barriers and identified the developments needed to facilitate RAS-based autonomous biodiversity monitoring. Some existing RAS could be optimized relatively easily to survey species but would require development to be suitable for monitoring of more 'difficult' taxa and robust enough to work under uncontrolled conditions within ecosystems. Other nascent technologies (for instance, new sensors and biodegradable robots) need accelerated research. Overall, it was felt that RAS could lead to major progress in monitoring of terrestrial biodiversity by supplementing rather than supplanting existing methods. Transdisciplinarity needs to be fostered between biodiversity and RAS experts so that future ideas and technologies can be codeveloped effectively.

Nature Ecology & Evolution **9:1031 (2025)**

Anopheles mosquito in the laboratory at Imperial College London, UK. Photo: Target Malaria.

A male-drive female-sterile system for the self-limited control of the malaria mosquito *Anopheles gambiae*

Despite great leaps forward in preventing and treating malaria, several challenges, including insecticide resistance, have hindered progress in fighting the disease. Thus, there is a pressing need for new tools to control malaria, including the use of genetically modified mosquitoes (GMMs) in the field. Various genetic strategies for vector control are currently explored, ranging from self-sustaining GMMs with unrestricted geographic and temporal spread to self-limiting alternatives. Professors Burt and Cristanti, Katie Willis and 5 other co-workers described a self-limiting gene drive strategy called Male Drive Female Sterile (MDFS) targeting *Anopheles gambiae*, a major malaria vector. The MDFS genetic construct causes dominant sterility in females, while transgenic males remain fertile, allowing them to transmit the female sterility trait at super-Mendelian rates. Laboratory studies showed that repeated releases of MDFS can lead to elimination of caged mosquito populations. Based on these findings, modelling suggests MDFS could be a highly effective and self-limiting strategy for suppressing wild malaria mosquito populations.

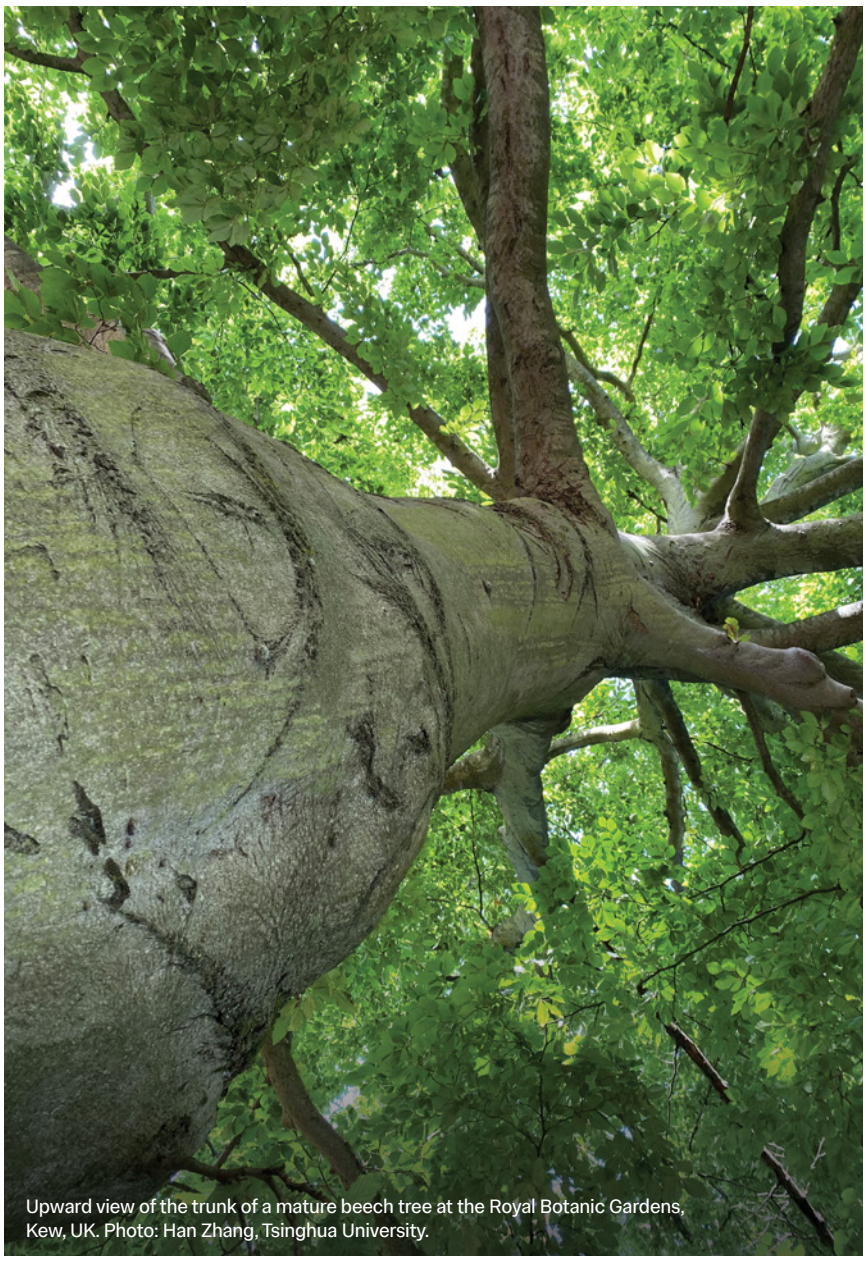
Nature Communication **16:9446 (2025)**

Tropical forest clearance impacts biodiversity and function, whereas logging changes structure

Tropical forests are highly diverse but are vulnerable to tree harvesting for timber and forest clearing for agriculture. Professors Ewers and Tobias and 36 co-authors studied how logging affects tropical forests using a standardised, replicated design across a gradient of land-use intensity in Borneo. The authors measured variables related to environmental changes, tree functional traits, ecosystem functions, and biodiversity of multiple taxa in plots with medium- or high-intensity logging, oil palm plantations, and old growth forests. Biodiversity was generally highest in old growth forests and significantly lower on oil palm plantations. Logging affected the environment, but biodiversity and ecosystem functions only showed strong responses to total forest conversion. These results demonstrate the complexity of land-use impacts on ecosystems.

***Science* 387:171 (2025)**

Tropical forest clearance for oil palm terraces in Sabah, Borneo.
Photo: Chi'en C. Lee.



Upward view of the trunk of a mature beech tree at the Royal Botanic Gardens, Kew, UK. Photo: Han Zhang, Tsinghua University.

Thermal acclimation of stem respiration implies a weaker carbon-climate feedback

Plant respiration contributes several times the amount of carbon emissions to the atmosphere as anthropogenic sources. Respiration also increases with temperature, leading to a positive feedback loop. However, plants can acclimatise to warmer temperatures and reduce their respiration rate. Using a model based on ecological-evolutionary optimality principles, Professor Prentice and 13 co-authors predicted the rate of respiration acclimation to warming driven by decreasing water viscosity within the plant. They then tested these predictions using a dataset of stem respiration measurements from 186 woody plant species collected in the field and laboratory. Incorporating thermal acclimation into emissions projections reduced the predicted terrestrial carbon emissions estimate by nearly one third.

***Science* 388:984 (2025)**

Embedding information flows within ecological networks

Natural communities form networks of species linked by interactions. Understanding the structure and dynamics of these ecological networks is pivotal to predicting species extinction risks, community stability and ecosystem functioning under global change. Traditionally, ecological network research has focused on interactions involving the flow of matter and energy, such as feeding or pollination. In nature, however, species also interact by intentionally or unintentionally exchanging information signals and cues that influence their behaviour and movement. Professor Pawar and 10 co-authors argued that this exchange of information between species constitutes an information network of nature—a crucial but largely neglected aspect of community organisation. They proposed to integrate information with matter flow interactions in multilayer networks. This integration revealed a novel classification of information links based on how the senders and receivers of information are embedded in food web motifs. They showed that synthesising information and matter flow interactions in multilayer networks can lead to shorter pathways connecting species and a denser aggregation of species in fewer modules. Ultimately, this tighter interconnectedness of species increases the risk of perturbation spread in natural communities, which undermines their stability. Understanding the information network of nature is thus crucial for predicting community dynamics in the era of global change.

***Nature Ecology & Evolution* 9:547 (2025)**

Outreach: science meets art

In July, Imperial's Silwood Park Campus in Ascot welcomed record crowds as the annual *Bugs, Birds & Beasts Day* returned bigger and better than ever. Visitors enjoyed an expanded programme of activities reflecting the event's growing popularity, demonstrating the campus's increasing reach to audiences beyond the local community, with this year also featuring art performances, including live music. Tried-and-tested favourites such as live bird egg hatchings, dramatic falconry displays, pond dipping and guided butterfly walks gave attendees the opportunity to observe and engage with local wildlife up close. Exciting new additions, including a nature-themed orchestra, the Mosquito Zoo, Grantham Institute exhibits, tree walks and story-time sessions, added fresh experiences to the day's programme and broadened its appeal to audiences of all ages. Guests also learned about the importance of biodiversity and how the natural world supports life, both visible and unseen, through a richer and more interactive experience than in previous years, strengthening public understanding of environmental research and its real-world relevance.

Bugs, Birds & Beasts Day 2025. Photo: Brendan Foster.

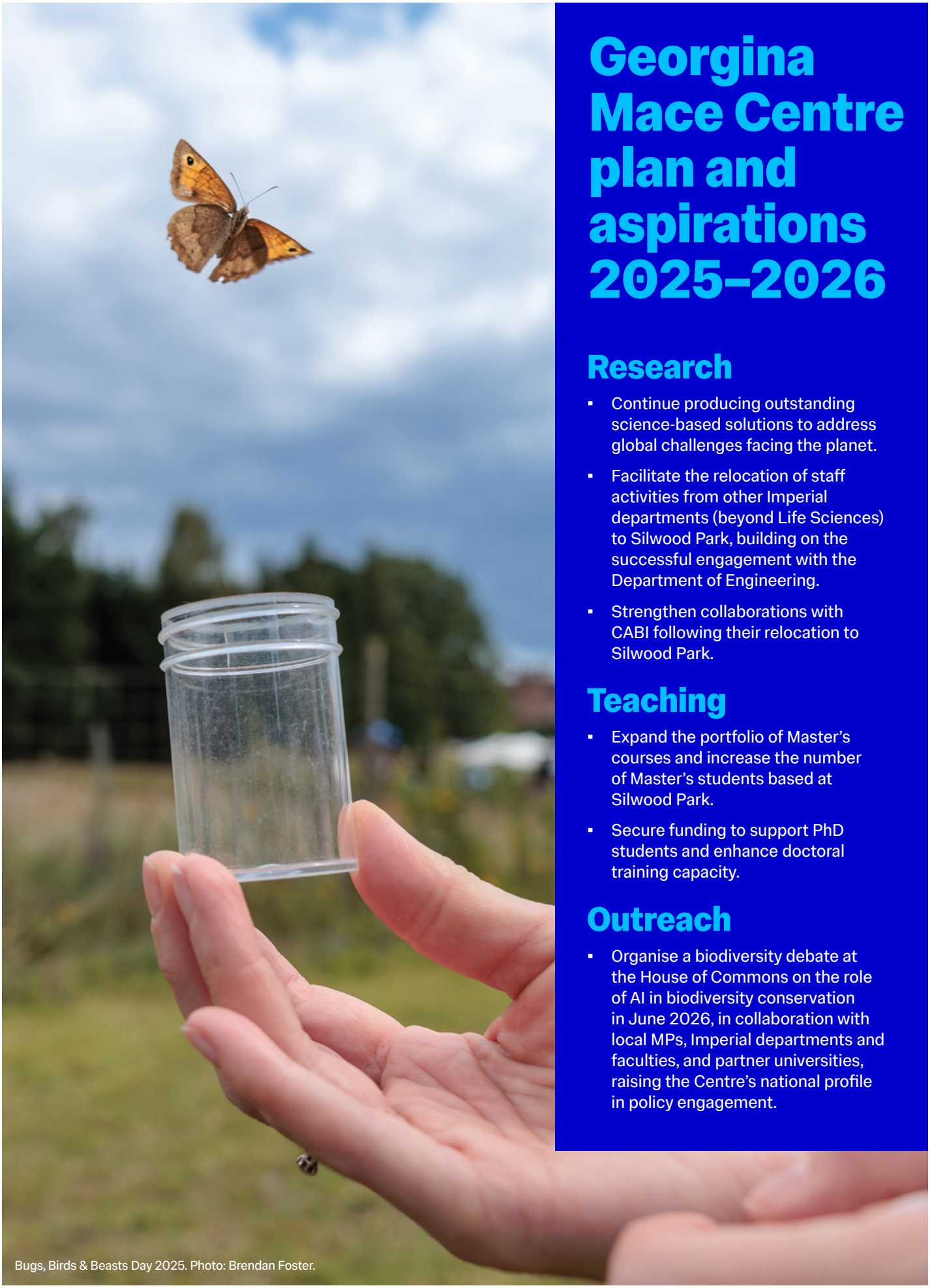
Bugs, Birds & Beasts Day 2025. Photo: Brendan Foster.

An illustration of a young adult male rhesus macaque. The male was identified and painted by Katarina Piponi, pictured, on her fieldwork site Cayo Santiago, Puerto Rico.

Art was also central to other outreach activities, highlighting the value of creative approaches in communicating science. PhD student Chloe Coxshall collaborated with artists on a stand celebrating the diversity of human traits and forms, encouraging inclusive conversations around variation and identity, while PhD student Katarina Piponi won the prize for Best Illustration at the annual conference of the *Primate Society of Great Britain*. Her illustration now features on the society's new T-shirt.

Photo: Chloë Coxshall.

Chloë Coxshall teamed up with artist Liane Haris to highlight diversity in nature at Great Exhibition Road Festival 2024. The stall encouraged conversations around diversity while visitors contributed to a visual display of diversity within our own community.



Bugs, Birds & Beasts Day 2025. Photo: Brendan Foster.

Georgina Mace Centre plan and aspirations 2025–2026

Research

- Continue producing outstanding science-based solutions to address global challenges facing the planet.
- Facilitate the relocation of staff activities from other Imperial departments (beyond Life Sciences) to Silwood Park, building on the successful engagement with the Department of Engineering.
- Strengthen collaborations with CABI following their relocation to Silwood Park.

Teaching

- Expand the portfolio of Master's courses and increase the number of Master's students based at Silwood Park.
- Secure funding to support PhD students and enhance doctoral training capacity.

Outreach

- Organise a biodiversity debate at the House of Commons on the role of AI in biodiversity conservation in June 2026, in collaboration with local MPs, Imperial departments and faculties, and partner universities, raising the Centre's national profile in policy engagement.

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Georgina Mace Centre for the Living Planet

Join the Georgina Mace Centre for the Living Planet

We are always looking for curious, creative thinkers ready to tackle the world's biggest environmental challenges. Why not spend your sabbatical with us? We welcome individuals from all sectors and are keen to build bold collaborations that bring together business, industry, and academia.

There are fellowship, sabbatical, and short-visit funding opportunities available, and we are happy to help you explore them. Come share your ideas, make connections, and help shape a more sustainable future with us.

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Journal collection Co-director Professor Mat Fisher is co-editing a forthcoming special collection with Kabir Peay at Stanford University exploring how fungi are responding to global environmental change.

The collection, **Fungi in a Changing World – Adaptation, Ecology, and Emerging Risks**, brings together interdisciplinary research on the expanding roles of fungi in ecosystem stability, agriculture, and emerging disease risks.

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