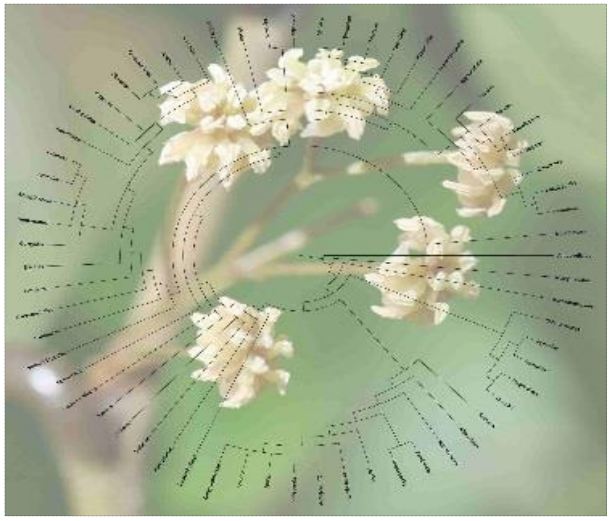
Queen Mary University of London

Royal Botanic Gardens Kew

MSc in Plant and Fungal Taxonomy, Diversity and Conservation

Student handbook




MSc in Plant and Fungal Taxonomy, Diversity and Conservation

Programme overview

This programme is designed to teach vital plant and fungal identification skills in the context of evolutionary biology and conservation theory and practice.

Students will be taught by world-leading experts from Queen Mary University of London (QMUL) and the Royal Botanic Gardens, Kew (Kew). Both institutions are internationally recognised for their cutting edge research in plant and fungal sciences, applying new technologies to answer fundamental questions about the diversity of plant and fungal life on this planet, how it evolved and how we can best conserve it.

Students will receive excellent research supervision during their individual research projects within established research teams at QMUL and Kew.

Students will have access to Kew's world-renowned collections of plant and fungal specimens and to the state-of-the-art analytical facilities at Kew and QMUL.

The programme includes an exciting tropical fieldwork module based in Madagascar, a biodiversity hotspot where students will be immersed in research and conservation activities.

Additional information for applicants:

For important supplementary information, please visit the course webpages:

https://www.qmul.ac.uk/sbcs/postgraduate/masters/courses/138996.html and

https://www.kew.org/science/training-and-education/msc-plant-and-fungal-taxonomy-diversity-conservation

Jars of seed stored in the Millennium Seed Bank

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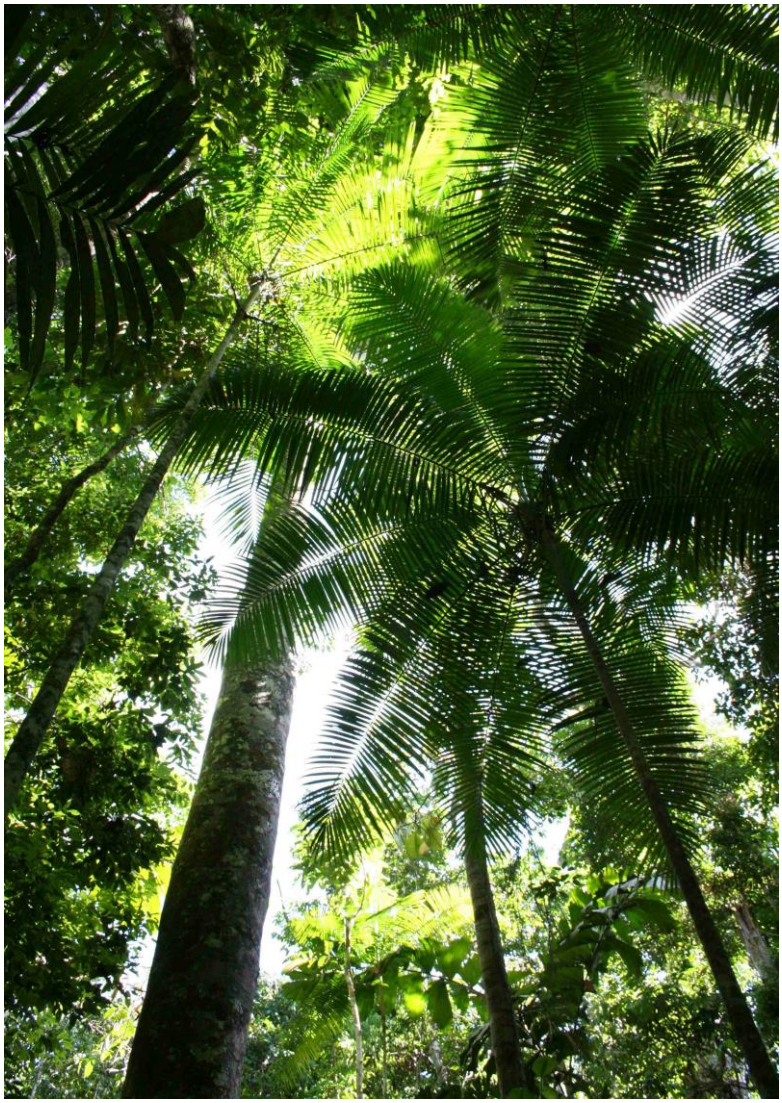
1 Aims, outcomes and assessment

1.1 Overall aims

With only a small percentage of the planet's diversity formally described by science, it is more important than ever to train a new generation of taxonomists who will go on to describe, understand and conserve biodiversity. The MSc in Plant and Fungal Taxonomy, Diversity and Conservation delivers vital plant and fungal identification skills in combination with a thorough grounding in molecular systematics, evolutionary biology, and conservation policy, theory and practice. The course will equip students with the knowledge and skills for further study in any area of taxonomy, molecular systematics, ecology, evolution or more applied conservation work. These will be relevant to many roles in academia, government, industry, consultancy and non-governmental organisations.

The programme will:

- enable students to develop a sound knowledge base in the subject areas studied
- enable students to develop key transferable skills in the areas of communication, numeracy, information technology, team-work, problem-solving, time and task management
- enable students to develop a portfolio of experimental skills and practical techniques
- give students the confidence to tackle extended research studies
- foster an enquiring, open-minded and creative attitude, tempered with scientific discipline and social awareness, which encourages lifelong learning



1.2 Course learning outcomes

The programme aims to teach the application of good scientific principles in combination with independent and innovative thought. Students will be expected to achieve an advanced, inter-disciplinary understanding of techniques and methodologies applicable to botanical, mycological and conservation science. They will also develop an appreciation of the current issues and research questions that are driving science forward during this period of unprecedented environmental change.

In particular, students will be able to:

- evaluate complex issues both systematically and creatively, make sound judgements in the absence of complete data, and communicate conclusions clearly to specialist and non-specialist audiences
- demonstrate self-direction and originality in tackling and solving problems
- act autonomously and professionally in planning and implementing tasks
- exercise initiative and personal responsibility
- undertake independent learning to supplement taught elements of the course

From a practical training perspective, students will:

- acquire technical expertise and be able to perform tasks smoothly, with precision and effectiveness
- be able to adapt skills and develop new techniques, for applications that engage with user needs

1.3 Teaching, learning and assessment strategies

The programme modules will be taught in two-week blocks, with a subsequent week-long study break for independent learning and fulfilling the requirements of continuous assessment exercises.

Modules will consist of a combination of lectures, seminars, discussion groups, workshops and field, laboratory or computer-based practicals.

Much of the theory gleaned from formal teaching during the modules in semesters A and B will be placed in a real-life context on the residential field course module. This will comprise site visits, field surveying and sampling, with input from expert researchers and practitioners.

The completion of a research project during the second half of the course, offers students the opportunity to apply and develop further theoretical and practical skills.

Outline of assessment for the award of MSc

Coursework (50% of final grade): Taught modules will be assessed using a variety of methods (reports, essays, practicals and presentations). Each module is weighted at 8.33% of the final assessment mark.

Dissertation (50% of final grade): The examination of the research project will consist of a scientific paper suitable for journal publication (90%) and a research seminar (10%).

Taught modules and the research project must each be passed at 50% for the MSc to be awarded.

2 Programme structure and timetable

The programme is structured to allow logical progression through the six core taught modules (15 credits each):

1. Plant Taxonomy and Diversity
2. Fungal Taxonomy and Diversity
3. Statistics and Bioinformatics
4. Research Frontiers in Evolutionary Biology
5. Conservation and Ecosystem Science
6. Field Study Skills in a Biodiversity Hotspot (residential course, based in Madagascar)

For the remainder of the programme, students will be engaged in a cutting edge research project (90 credits), undertaking a piece of independent and novel research that draws upon much of the knowledge and skills learnt.

Students are encouraged to use their independent study time to engage with current researchers in labs, thereby exposing themselves to the day-to-day experience of a research environment.

Students are also encouraged to attend seminars and lab specific meetings to gain a good understanding of the breadth of research at Kew and QMUL before choosing their own specific project.

2.1 Core taught modules

Semester A – BIO741P Plant Taxonomy and Diversity – 15 credits

Staff: Gemma Bramley and Anna Trias Blasis (module co-ordinators), Paula Rudall, Eve Lucas, Pete Gasson, Tim Utteridge, John Dickie, Gerhard Prenner, Anna Haigh, Chrissie Prychid, Ilia Leitch, Oriane Hidalgo, Bente Klitgaard, Heather Lindon, Helen Hartley, Sidonie Bellot, Oscar Perez Escobar, Juan Viruel, Rowan Schley, Bruce Murphy, Andre Schuiteman, Peter Petoe, Gwil Lewis, Felix Forest

This module will provide an overview of global plant diversity, with a particular focus on flowering plants. It will be taught at Kew by leading botanists, giving students the opportunity to explore the outstanding collections and facilities housed there. Topics will range from taxonomic principles and methodology, plant systematics and comparative biology (including morphology, chemistry and genomics), phylogenetics, biogeography and evolution. The module will have a strong practical component, providing excellent hands-on experience for students.

The aim is to introduce students to the many different fields of research used in the study of plant diversity. With this broad foundation, students will be equipped with an extensive skill set which they can apply to their choice of the wide range of research projects available on this course, and to their future careers.

Module learning outcomes

Students will gain:

- a comprehensive understanding of global plant diversity, plant evolution, flowering plant morphology and classification
- detailed knowledge of the concepts and applications of plant taxonomy, systematics and phylogenetics
- a critical appreciation of the value of taxonomy and systematics as the basis for pure and applied research

Students will be able to:

- demonstrate a conceptual understanding of the information and techniques used by taxonomists to document and describe plant diversity, and by systematists to hypothesise inter-plant evolutionary relationships
- address biological questions concerning ecology, evolution and conservation, using taxonomic and systematic data
- apply their knowledge of plant morphology to interpret and describe plants from key external attributes; understand how this knowledge can inform the identification process
- critically appraise plant diversity knowledge to identify any gaps and the appropriate methods that could be used to address these

Reading and reference list

Bell, A. D. & Bryan A. (2008). *Plant Form: An Illustrated Guide to Flowering Plant Morphology*. Timber Press. ISBN 978088192850.

Beentje, H. J. (2010). *The Kew Plant Glossary: an illustrated dictionary of plant terms*. Royal Botanic Gardens, Kew. ISBN 9781842464229.

Glover, B. J. (2014). *Understanding Flowers and Flowering: an Integrated Approach*. Oxford University Press. ISBN 9780199661596.

Heywood, V. H., Brummitt, R. K., Culham, A. & Seberg, O. (2007). *Flowering Plant Families of the World*. Royal Botanic Gardens, Kew. ISBN 9781554072064.

Judd, W. S. (2007). *Plant Systematics: a phylogenetic approach*. Sinauer Associates. ISBN 9780878934072.

Soltis, D. E., Soltis, P. S., Endress, P. K. & Chase, M. W. *et al*. (2005). *Phylogeny and Evolution of Angiosperms*. Sinauer. ISBN 0878938176.

Stuessy, T. F. (2009). *Plant Taxonomy: The Systematic Evaluation of Comparative Data*. Columbia University Press. ISBN 9780231147125.

Utteridge, T. M. A. & Bramley, G. (2014). *Tropical Plant Families Identification Handbook.* Royal Botanic Gardens, Kew. ISBN 9781842463819.

Willis, K. J. & McElwain, J. C. (2013). *The Evolution of Plants*. Oxford University Press. ISBN 9780199292233.

Semester A – BIO743P Fungal Taxonomy and Diversity – 15 credits

Staff: Laura Martinez-Suz (module co-ordinator), Ester Gaya, Pepijn Kooij, Begona Aguirre-Hudson, Tuula Niskanen, Martyn Ainsworth, Kare Limatainen, Paul Cannon, Ricardo Arraiano-Castilho

This module will focus on fungal diversity, taxonomy and conservation, and will be taught at Kew by leading mycologists. Kew has the world's largest collection of fungal specimens, which will be available to students during the course. The module will give an overview of the systematics and taxonomy of major fungal groups, with an evolutionary perspective. It will also cover basic concepts in mycology, field collecting and culturing, and fungarium techniques (collections management). In addition, fungal ecology (e.g. symbiosis, 'rotters and recyclers', pathogens), biogeography and evolutionary genomics will be explored through the study of contemporary, front-line research. The module will have a strong practical component.

This module will provide both a practical approach and holistic knowledge to address scientific questions relating to fungi. It will particularly appeal to microbiologists, ecologists, evolutionary biologists, conservation biologists and population geneticists. This module also aims to inspire students to seek a career in fungal research and to equip them with the knowledge and skills to make contributions to research on fungal diversity, evolution, ecology and conservation, and its applications.

Module learning outcomes

Students will be able to:

- synthesise data on fungal diversity, systematics and evolution, with a comprehensive overview of the contemporary methods and techniques used in their investigation
- critically review the body of knowledge on the ecological roles of fungi and their interactions with other organisms using primary and secondary sources
- employ theoretical concepts and practical skills on the collection, culturing, laboratory manipulation and preservation of fungi
- identify broad groups of fungi, based on their morphological and anatomical characteristics, and accurately describe their evolution and ecology
- evaluate the relationships among fungi and with other organisms, and how these drive fungal evolution

Reading and reference list

Alexopoulos, C. J., Mims, C. W. & Blackwell M. (1996). Kingdom Fungi: Introduction to fungi and their significance to humans. In: *Introductory Mycology*, 4th edition. John Wiley & Sons, Inc. ISBN 710907398X (for 2002 edition).

Blackwell, M. & Spatafora, J. W. (2004). Fungi and their allies. In: Mueller, G.M., Bills, G.F. & Foster, M. S. *Biodiversity of Fungi: Inventory and Monitoring Methods.* Amsterdam: Elsevier Academic Press. ISBN 0125095511.

Bruns, T. (2006). Evolutionary biology: a kingdom revised. *Nature* 443: 758–761.

James, T. Y., Kauff, F., Schoch C. L., Matheny, P. B., Hofstetter, V., *et al*. (2006). Reconstructing the early evolution of fungi using a six-gene phylogeny. *Nature* 443: 818–822.

McLaughlin, D. J. M., Hibbett, D. S., Lutzoni, F., Spatafora, J. W. & Vilgalys, R. (2009). The search for the fungal tree of life. *Trends Microbiol.* 17:488–497.

Mycologia (2006). Deep hypha (special issue).

Mueller, G. M., Bills, G. F., & Foster, M. S. (Eds.). (2004). *Biodiversity of fungi: inventory and monitoring methods*. Academic Press. ISBN 710907398X.

Nash, T. H. III (ed.) (2008). *Lichen Biology*. 2nd edition. Cambridge: Cambridge University Press.

Smith, S. & Read, D. (2008) *Mycorrhizal symbiosis.* 3rd edition. Academic Press. ISBN 978-0-1237-0526-6.

Semester A – BIO781P Statistics & Bioinformatics – 15 credits

This module is shared with the MScs in Bioinformatics; Ecology and Evolutionary Genomics; Aquatic Ecology by Research; Freshwater and Marine Ecology; and Ecology and Evolutionary Biology.

Staff: Rob Knell, Steve Le Comber, Yannick Wurm.

This module provides students with essential training in experimental design, data handling and data analyses in a context appropriate for environmental and evolutionary biology. The module will establish a solid foundation from previous knowledge and then progress to more advanced methods. The course focuses on how to select the appropriate method of analysis, how to analyse data using the statistical programming language R, and how to interpret the output of that analysis. The first half of the module will deal with parametric statistics, including general and generalised linear models, and the second half will move onto multivariate statistics and the basics of Bayesian analysis.

Reading list

Knell, R. *Introductory R*. http://www.introductoryr.co.uk

Semester A – BIO731P Research Frontiers in Evolutionary Biology – 15 credits

This module is shared with the MScs in Ecology and Evolutionary Genomics; and Ecology and Evolutionary Biology.

Staff: Richard Buggs, Richard Nichols, Steve Rossiter, Andrew Leitch. Guest lecturers: James Shapiro (University of Chicago), Ilia Leitch (RBG Kew), Richard Bateman (RBG Kew).

We will explore the frontiers of research in evolutionary biology. Topics covered will include: gene trees versus species trees, phylogenomics, neutral versus selective forces, molecular convergence, the origin of angiosperms, the evolution of sociality, the significance of whole genome duplication and hybridisation. Current methods used to tackle these areas will be taught, with an emphasis on DNA sequence analysis and bioinformatics.

Whereas undergraduate degrees commonly focus on what we know, this Master's module will shift the focus onto what we don't know. You will learn to ask relevant questions, and design approaches to seeking answers to those questions.

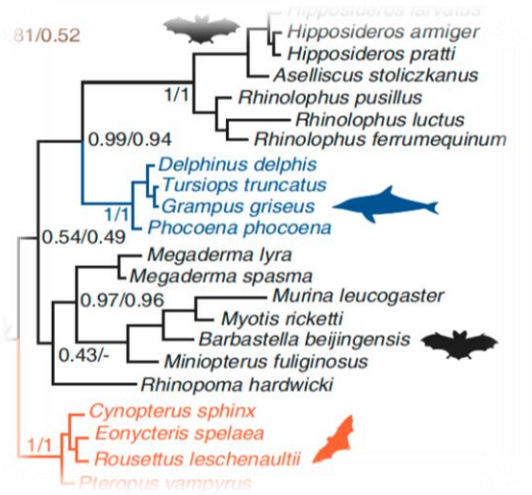
Reading list

Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. & Patel, N. H. (2007). *Evolution*. Cold Spring Harbor Press. ISBN 9780879696849.

Lynch, M. (2007). *The Origins of Genome Architecture*, Sinauer. ISBN 9780878934843.

Sherratt, T. N. & Wilkinson, D. M. (2009). *Big Questions in Ecology and Evolution*. Oxford University Press. ISBN 9780199548613.

Lane, N. (2009). *Life Ascending: The Ten Great Inventions of Evolution*. Norton/Profile. ISBN 9780393338669.



Semester B – BIO745P Conservation and Ecosystem Science – 15 credits

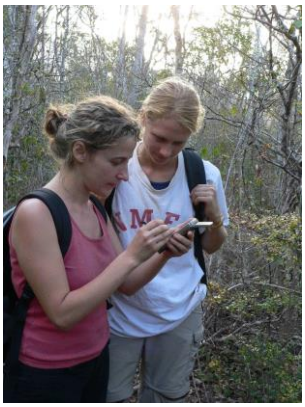
Staff: Mike Fay (module coordinator) Aaron Davis, Mark Nesbitt, John Dickie, Michael Way, Charlotte Seal, China Williams, Carly Cowell, Sonia Dhanda, Valentina Vaglica, Colin Clubbe, Phil Stevenson, Hauke Koch, Sara Redstone, Viswambharan Sarasan, Jonathan Kendon, Juan Viruel, Roberta Gargiulo, Steve Bachman, Isabel Larridon, Hassan Rankou, Tiziana Ulian, Jenny Williams, Carolina Tovar, Sam Pironon, Martyn Ainsworth, Eimear Nic Lughadha

This module will explore the role and application of plant and fungal science in integrated conservation and management of biodiversity; the delivery of ecosystem services and livelihoods; and the development of mechanisms for their maintenance and restoration in the context of a changing planet. Drawing on the exceptional breadth of expertise, collections and facilities across Kew's sites, it will provide an essential introduction to a range of technical approaches, including policy development, species and habitat prioritisation, protected area management, conservation genetics, ecosystem service research, seed banking and propagation, application of traditional knowledge, and integrated conservation for biodiversity and livelihoods.

The module aims to build students' understanding of the roles of plants and fungi in meeting conservation challenges — from species' taxonomy and diversity to their value as natural capital. It aims to equip students with an understanding of the range of relevant practical skills and techniques, and to inspire them to apply them in their career development. It will also provide the framework for assessing conservation challenges and evaluating relevant policy issues, targeting and designing scientific research to fill knowledge gaps and support conservation implementation.

Module learning outcomes

Students will gain:



- knowledge of the roles of plant and fungal science in species and habitat conservation (including assessment of threats), ecosystem service delivery/management, and livelihoods
- a broad understanding of the roles of plants, fungi and habitats in the delivery of ecosystem services
- knowledge and understanding of the relevant policy frameworks
- critical appreciation of the range of approaches and techniques for developing and applying the relevant science to addressing knowledge gaps and finding solutions

Students will be able to:

- demonstrate practical understanding of how established techniques for research and enquiry are used to create and interpret knowledge in the context of conservation and ecosystem services
- demonstrate capacity to synthesise and critically evaluate current research in conservation and ecosystem services
- demonstrate capacity to evaluate methodologies and propose appropriate approaches for their application in a range of contexts

Reading and reference list

Allendorf, F., Luikart, G. & Aitken, S. (2013). *Conservation and the genetics of populations*. Wiley-Blackwell. ISBN 9780470671467.

Ausden, M. (2007). *Habitat Management for Conservation: A Handbook of Techniques*. Oxford University Press. ISBN 9780198568728.

Cotton, C. M. (1996). *Ethnobotany: Principles and Applications*. John Wiley. ISBN 0471968315 or 047195537X.

Guerrant, E., Havens, K. & Maunder, M. (2004). *Ex Situ Plant Conservation: Supporting Species Survival in the Wild*. Island Press. ISBN 1559638753.

Helm, D. & Hepburn C. eds. (2014) *Nature in the Balance – The Economics of Biodiversity*. Oxford University Press. ISBN 9780199676880.

Semester B – BIO799P Field Skills in a Biodiversity Hotspot – 15 credits

Staff: David Goyder (module co-ordinator), Maria Vorontsova, Zoe Goodwin, Pepijn Kooij, Kew Madagascar Conservation Centre staff and other rotating staff members.

This field course module will take place in Madagascar and will provide an introduction to practical field work, including botanical surveys and flowering plant identification. It will also cover how these can be applied to solving practical problems of conservation management and biodiversity research. It will be taught by botanists and mycologists from the RBG Kew, the Kew Madagascar Conservation Centre (KMCC) in Antananarivo, and local conservationists and researchers from collaborating institutions. Several site visits to conservation projects, along with taught case studies, will give an overview of conservation in Madagascar.

This module aims to provide students with practical experience in the field, in order to develop field skills and learn about conservation in Madagascar. It will provide a real-world context for the taught elements of the MSc programme.

We reserve the right to change the location of this course if advice on travel to Madagascar from the Foreign Commonwealth Office changes, or for logistical reasons. For students unable to travel to Madagascar for this module, an alternative method of assessment will be undertaken.

Module learning outcomes

Students will gain:

- a comprehensive understanding of plant diversity, distribution and evolution in Madagascar
- a detailed understanding of the processes that threaten biodiversity and ecosystem services in Madagascar, and the measures that have been taken by the conservation and development communities over the last 10 years
- a critical appreciation of how taxonomy and systematics can inform biodiversity conservation

Students will be able to:

- identify plants confidently, using a knowledge of how to incorporate the range of the tools available
- demonstrate competence in undertaking an IUCN Red-list Assessment

Reading and reference list

Austin, D. (2014). *Bradt Travel Guide for Madagascar*. Bradt. ISBN 9781841624983.

Dransfield, J., Beentje, H., Britt, A., Ranarivelo, T. & Razafitsalama, J. (2006). *Field Guide to the Palms of Madagascar*. Royal Botanic Gardens, Kew. ISBN 1842461575.

Moat, J. & Smith, P. (2007). *Atlas of the Vegetation of Madagascar*. Royal Botanic Gardens, Kew. ISBN 9781842461983.

Schatz, G. E., (2001). *Generic Tree Flora of Madagascar*. Royal Botanic Gardens, Kew and Missouri Botanical Garden. ISBN 1900347822.

2.2 Individual research project (dissertation)

Semesters B & C – BIO709P Plant and Fungal Taxonomy, Diversity and Conservation Research Project

Staff: Andrew Leitch and Richard Gianfrancesco (module co-ordinators), various others – projects are offered by staff at Kew and QMUL according to research interests and expertise.

The individual research project will form 50% of the course mark (90 credits). The project will enable students to focus on an area that interests them, using Kew's vast scientific collections for investigative research. Projects can be based at either institution (Kew or QMUL) depending on the specialism or can have joint supervision with time spent at both institutions. Laboratory facilities are available at both institutions (see section 3.3).

This module will involve a novel piece of research, typically either a desk-based study or an experimental study with associated data analysis. Most projects are chosen from those offered to students by research staff, so that students can benefit from close alignment with the current research of specific groups at QMUL or Kew. The diversity of expertise among the programme's lecturers means that good supervision can be found for a broad range of studies, from plant conservation to fungal systematics, at local, national or international scales.

Students will write up the results of their research project as a scientific paper that aims to make a novel contribution to scientific knowledge. They will also present a research seminar based on their work, to an audience of staff and peers who will have the opportunity to ask questions. In both elements, students should demonstrate familiarity with the relevant literature, current scientific understanding and the challenges to which the research contributes. In undertaking such an extensive project, students are expected to show a sound understanding of project design, sample collection and data analysis, as well as the ability to produce a coherent and well-structured written report.

During semester A, students will be encouraged to talk with potential supervisors, current PhD students and Career Development Fellows (CDFs). From March through to the end of July, students will undertake lab or field work, and then write up in August for an early September submission. Student research seminar presentations will take place at the end of June.

Projects based at Kew will contribute to the 2020 Science Strategic Outputs:

- Plants of the World Online Portal
- State of the World's Plants
- Tropical Important Plant Areas
- The Plant and Fungal Trees of Life
- Banking the World's Seeds
- Useful Plants and Fungi Portal
- Digitising the Collections
- Training the Next Generation of Plant and Fungal Scientists
- Science in the Gardens

Students will be given a list of potential projects and will also be given the opportunity to develop their own projects in agreement with supervisors.

For further details on the research interests of potential supervisors, please visit Kew's Science Directory (https://www.kew.org/science/who-we-are-and-what-we-do/people) and the Queen Mary Academic Staff web pages (http://www.sbcs.qmul.ac.uk/research) or follow our exploits via Twitter @QM_SBCS, @KewScience.

3 Wider participation in the academic community

3.1 Links with other QMUL MSc courses

This MSc programme has one or more modules shared with the following MSc programmes taught by the School of Biological and Chemical Sciences at QMUL:

- Aquatic Ecology by Research
- Bioinformatics
- Evolutionary and Ecological Genomics
- Ecology and Evolutionary Biology
- Freshwater and Marine Ecology

This gives rise to a vibrant postgraduate community and access to well-established procedures/facilities, including induction/training programmes and excellent teaching/IT facilities at QMUL.

3.2 Science lectures at Kew and in London

Students will also be able to attend other relevant lectures in London and at Kew as part of several different seminar programmes, including:

- QMUL School of Biological and Chemical Sciences seminar series
- QMUL Geography seminar series
- Kew Science weekly 'KABaM' (Kew Advances in Botany and Mycology) seminars in the Jodrell lecture theatre, Mondays at 13.00–14.00.
- Kew Science seminar series, held monthly with external guest lecturers (Jodrell, Mondays at 13.00–14.00)
- Kew Mutual Improvement Society (KMIS) seminar series (Mondays at 18.00–19.30)
- Linnean Society of London meetings and lectures (http://www.linnean.org/Meetings-and-Events)
- London Centre for Ecology and Evolution (http://www.ceevol.co.uk)

A programme of relevant lectures is communicated regularly by email.

3.3 Facilities

Organismal Biology Department at QMUL

Organismal Biology has a broad remit, from molecules to the global biosphere, uniting many disciplines both within and outside the natural sciences. The department is home to an active, cutting edge research programme. Our research staff are engaged in a wide range of ground-breaking projects across the broad sweep of biological, chemical and psychological sciences. Much of this work is made possible by the wide range of in-house analytical services and core facilities, including an analytical laboratory, bright field and epi-fluorescent microscopy, confocal microscopy, digital and photographic imaging centre (DPIC), EPR facility, high field liquid phase and solid state NMR, medium field liquid phase and solid state NMR, protein purification facility, transmission electron microscopy (TEM), and an X-ray diffraction facility. Research activity is also extended and supported by a range of collaborative research centres.

The Evolution and Genetics team has substantial expertise in ecological and evolutionary consequences of speciation and hybridisation, and leads in the application of next generation sequencing technologies (gene expression, comparative genomics and population genetics) to resolve patterns and processes associated with genome and gene divergence, and the evolution of social systems.

Royal Botanic Gardens, Kew

Kew has the largest collections of living and preserved plants in Europe including one of the world's largest herbaria, the world's biggest seed bank of wild-collected seeds, and the world's largest wild plant DNA bank. These are complemented by a staff of over 250 highly skilled scientists, curators and technicians located in three purpose-built buildings: the Herbarium, the Jodrell Laboratory (both located at Kew) and the Wellcome Trust Millennium Building (housing the Millennium Seed Bank, located at Wakehurst, West Sussex). The combination of world-class expertise and our collections makes Kew a truly global resource in plant and fungal knowledge.

Kew's scientific vision is to document and understand global plant and fungal diversity and its uses, bringing authoritative expertise to bear on the critical challenges facing humanity today. Kew's portfolio of scientific research addresses three strategic priorities (listed below) through activities within six themed science departments (Collections; Identification and Naming; Comparative Plant and Fungal Biology; Conservation Science; Natural Capital and Plant Health; and Biodiversity Informatics and Spatial Analysis). Full details can be found in Kew's *Science Strategy 2015–2020*

Kew's three strategic priorities:

1) To document and conduct research into global plant and fungal diversity and its uses for humanity.
2) To curate and provide data-rich evidence from Kew's unrivalled collections as a global asset for scientific research
3) To disseminate our scientific knowledge of plants and fungi, maximising its impact in science, education, conservation policy and management

These priorities enable us to curate, use, enhance, explore and share Kew's global resource, providing robust data and a strong evidence base for our UK and global stakeholders.

Herbarium and Economic Botany Collection (EBC)

Kew's Herbarium houses over 7 million preserved plant specimens (dried and in alcohol), including 350,000 type specimens. This world-class, globally and historically diverse collection continues to form the reference backbone for plant identification, whilst associated biodiversity and plant usage data (from collection labels and Kew's databases) provide critical additional information.

The Economic Botany Collection has 95,000 artefacts and samples relating directly to human uses of plants and plant products. The EBC illustrates the extent of human use of plants around the world, ranging from foods, medicines and utensils, to social activities and clothing. The EBC builds an important bridge between biological and cultural diversity, and is a valuable resource for the study of plant uses – past, present and future.

Jodrell Laboratory and Fungarium

Studies in the Jodrell Laboratory range across biochemistry, genetics, molecular biology, micromorphology (the study of plant structures at a microscopic level) and mycology (the study of fungi). The laboratories include state-of-the-art micromorphology, molecular biology, karyological, cytogenetic and genome size facilities; digital scanning and transmission electron microscopes; and high throughput sequencing capabilities. The Jodrell houses Kew's Fungarium, the largest of its kind in the world, containing 1.25 million specimens of dried fungi, including approximately 50,000 types. The world's largest wild plant DNA and tissue bank (including 45,000 DNA samples representing 35,000 species) and over 150,000 glass slides detailing plant micro-traits are also held within the Jodrell Laboratory.

Millennium Seed Bank (MSB)

The MSB is a state-of-the-art conservation centre containing seed collections from 94% of UK flora species that are both bankable and produce seed in the UK. In total, Kew holds over 2 billion seeds representing more than 36,000 species from 183 countries. It is on track to meet a target of banking seeds from 25% of the world's plant species by 2020. The seeds are stored at -20^{o}C and most will last for more than 200 years. This facility is at Kew's sister site at Wakehurst.

Living Collection

Kew's Living Collection of 19,000 plant species (40,000 plants) is held within the gardens (herbaceous beds, plant family beds, arboretum, grass garden etc.), glasshouses and nurseries at Kew and Wakehurst. These living plants are essential for Kew's national and international conservation work, and provide an essential source of fresh material for laboratory studies.

Library, Art & Archives

Kew's Library is the largest of its type in the UK, housing 170,000 monographs, 150,000 pamphlets, 5,000 serial titles and 11,000 maps. This material encompasses all topics covered in the MSc course (plant sciences, mycology, conservation and sustainable use).

The books and journals that are relevant to the course are held in two locations: botanical materials within the main library (in the Herbarium complex) and mycological materials within the Jodrell Laboratory basement (which is easily accessible from the designated MSc suite in the Jodrell). Locations for all of the books can be found via the Library Catalogue (http://kew.ent.sirsidynix.net.uk/) and digitised versions of some relevant titles can be found via the Biodiversity Heritage Library (http://www.biodiversitylibrary.org/).

Kew's botanical and mycological journal holdings are extensive (5,000 hard copy journal titles). Online access is provided on-site to c.300 journals via the Library Catalogue (http://kew.ent.sirsidynix.net.uk/).

The Archives and Illustrations collections hold 7 million sheets of letters and private papers; 200,000 plant drawings, watercolours and prints; and 205,000 photographs of Kew, people and plants. Many different languages are represented. The Archives relate to both the history of Kew and botany more generally, and date mostly from 1800 to the present day. They include corporate archives as well as the papers of eminent botanists. These collections can be consulted by students, in particular for the individual research project.

Botanical data resources

Alongside the physical collections, Kew holds a vast and growing collection of plant and fungal related data and databases which store information on collections, names, taxonomy, traits, distributions, phylogenies, phenology and conservation. These include the International Plant Names Index, World Checklist of Selected Plant Families, The Plant List, eMonocot, Legumes of the World Online, Plant DNA C-values Database, Seed Information Database and online collection catalogues.

4 Further information

Information on fees, financial support and studying at QMUL can be obtained from the address below:

Postgraduate Admissions
School of Biological and Chemical Sciences
Queen Mary University of London
Mile End, London E1 4NS
Tel: 0207 882 3328
Email: sbcs-pgadmissions@qmul.ac.uk

Or visit the website www.qmul.ac.uk

Information regarding *scientific* content of the course can be obtained from the address below:

Science Education and Communication Team
Office of the Science Directorate
Jodrell Laboratory
Royal Botanic Gardens, Kew
Richmond
Surrey, TW9 3AE
Tel: 0208 332 5625
Fax: 0208 332 5278
Email: kewscience@kew.org

Or visit the website https://www.kew.org/science/training-and-education/msc-plant-and-fungal-taxonomy-diversity-conservation

While every effort has been made to ensure that the information in this handbook is correct at the time of going to press, neither Kew nor QMUL can be held responsible for any errors it contains. The School reserves the right to cancel or make adjustments to the specifications of particular modules if necessary.