University of Glasgow

Institute of Biodiversity, Animal Health & Comparative Medicine

Institute of Biodiversity, Animal Health & Comparative Medicine (IBAHCM)

Master's Programmes Courses

2019-2020

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Note for PhD students interested in the Master's courses

This is a summary of the courses offered through our Master's programmes. If space permits, PhD students may be able to audit these courses, which can count towards their official credits. To express our interest, please fill out the google sheets document (https://docs.google.com/spreadsheets/d/1dsDrvpK50tqOgiO-ISWdq8LlGepph0MjunNDWf7BHkQ/edit?usp=sharing); you will be contacted by the relevant instructor if there is space.

You will also be given access to the relevant MOODLE sites. If you are only interested in particular components of Key Research Skills (Scientific Communication, Introduction to R, Basic statistics, Advanced statistics), please select which you would be interested in (or select all if you would like to attend the whole course).

An overview of when the courses are taught is provided on the following: https://docs.google.com/spreadsheets/d/1lGauQ1hTAWcKLqmYQMPcgz4sWbXzO9l3Fud8BXwZFDA/edit?usp=sharing.

Detailed Course Descriptions

Term 1 Core Courses:
BIOL 5126: Key Research Skills (required for all; 40 credits)

Course Coordinator: Prof. Barbara Mable (Barbara.mable@glasgow.ac.uk)

Core Instructors: Prof. Daniel Haydon (Daniel.haydon@glasgow.ac.uk), Dr. Roman Biek (roman.biek@glasgow.ac.uk), Dr. Sofie Spatharis (sofie.spatharis@glasgow.ac.uk), Dr. Paul Johnson (paul.johnson@glasgow.ac.uk), Dr. Jo Halliday (jo.halliday@glasgow.ac.uk), Dr. Tiziana Lembo (tiziana.lembo@glasgow.ac.uk), Dr. Simon Babayan (simon.babayan@glasgow.ac.uk)

Course Aims: The aims of this course are to ensure that all students enrolled in the MSc/PGdip and MRES programmes receive advanced and evidence-based training in the key skills essential for any modern ecology/evolution-based research career and for the courses that they will take later in the programme. All sessions will involve practical hands-on training, as well as lectures introducing the concepts. Sessions are divided broadly into: 1) Scientific Communication and 2) R & Statistics (including Introduction to the Programming Environment R, Introduction to General Linear Models, Advanced Statistics, and Experimental Design & Power Analysis).

Intended Learning Outcomes
By the end of this course students will be able to:

- Carry out an appropriate and thorough search of the primary literature.
- Critique scientific evidence
- Produce well-structured and critical evidence based essays, grant proposals and scientific reports that set the context of the objectives based on a critical review of the primary literature, and clearly describe methodology (including quantitative analyses), present results in an easily understandable format, and discuss results in the context of the broader body of literature in the relevant scientific field
- Download and install R, along with packages and libraries relevant to the analysis of biological data, import data, use objects, and plot data, acquiring technical help as required from literature and online sources
- Critically discuss appropriate uses of some of the key features of R including random number generation, data manipulation, input output, and basic descriptive statistics.
- Use R to implement a wide range of generalised linear mixed models, and discuss critically the justification for choice of models for particular scientific questions
- Organize data in a form appropriate for further analysis
- Use the evidence base to formulate null and alternate hypotheses associated with particular statistical tests
- Critically interpret the output from these analyses, test identified hypotheses and discuss the results in the context of the primary literature
- Recognize and critically assess the underlying models associated with these statistical analyses
- Identify and interpret statistical interactions and random effects in the context of real data
- Conduct a full range of diagnostic tests to ensure the data complies with assumptions of the methodology
- Take an critical evidence-based approach to designing effective experiments (and other data collection exercises)
- Critically evaluate other scientists' experimental designs
- Critically discuss the key concepts in experimental design with reference to the literature
- Integrate knowledge and skills learned in the analysis of experimental data and scientific writing to write a report using real data to generate a specific hypothesis to be tested in the context of a critique of the existing background in the primary literature, describe the specific methods used to analyse the data, describe and interpret the results based on the evidence base and write a critical discussion that sets the results in the context of the primary literature

Assessment: In-class and home assignments (coursework) will comprise 60% of the mark and will be divided equally between the Scientific Communications and R components. The remaining 40% of the mark will be based on a scientific report (3000 words) in the form of a publishable journal article that will integrate skills across all topics. Specifically, students will be provided with a dataset and a brief description of the motivation for why the data were collected. They will need to analyse the data using the skills learned in the introduction to R, Experimental design, and Advanced Statistics components and write up the report as a full scientific paper appropriate for submission to a peer-reviewed journal.

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BIOL5115: Animal Welfare Science (Required for AWSEL; 20 credits)

Course Coordinators: Dr Ruedi Nager (ruedi.nager@glasgow.ac.uk), Dr. Dorothy McKeegan (Dorothy.mckeegan@glasgow.ac.uk)

Course Aims: The aim of the course is to provide students with an evidence-based critical and detailed understanding of the concept of welfare and the range of issues animals are facing in various contexts.

Intended Learning Outcomes
By the end of this course students will be able to critically evaluate with respect to literature:
- The complexity of the concept of welfare and critically analyse the application of different welfare concepts
- Approaches for analysing and evaluating appropriate methods that can be used to assess specific welfare issues
- The latest issues and outcomes of research into animal welfare issues

In addition, they will:
- Obtain knowledge of welfare issues in different forms of human use of animals and be able to have an informed discussion and make critical judgements about a range of welfare issues
- Apply critical analysis, evaluation and synthesis of principles of welfare to work with wild animals

Assessment: Students will write a review essay (2000 words) researching the welfare issues associated with a particular animal (50%), write a critical evaluation and synthesis exercise (1000 words, 25%) and creating an informative leaflet (25%).

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BIOL5326: Core Skills in Epidemiology of Infectious Disease (Required for EIDAR; 20 credits)

Course Coordinator: Prof. Louise Matthews (louise.matthews@glasgow.ac.uk)

Course Aims: The aims of the course are to: equip students with an understanding of core epidemiological terminology, concepts and principles; enable the students to understand and critically evaluate epidemiological studies in the literature; provide the students with the skills to conduct simple epidemiological calculations and analyses; and provide students with the knowledge and skills to appropriately design an epidemiological study.

Intended Learning Outcomes
Knowledge and Understanding: Upon completion of the course, the students will be able to:
- Critically evaluate and explain core epidemiological terminology, with reference to different types of data and study design
- Critically evaluate and deploy the core concepts and principles underpinning epidemiological study design and data analysis

- Critically evaluate and discuss the alternative types of epidemiological study and methods that may used to address epidemiological questions

Skills and Other Attributes: On completion of the course, students will be capable of:
(i)Intellectual skills
- Identifying study designs appropriate for addressing given epidemiological questions
- Conducting simple calculations and analyses relevant to study design and data analysis
- Critically appraising scientific data and methods from the literature
- Formulating a research question or hypothesis
- Presenting analysis of data in form of scientific report

(ii)Transferable/key skills
- Reading and critical evaluation of scientific reports
- Oral communication of scientific subject matter
- Using statistical and database software for computation and data analysis

Assessment: Two written assignments, including a 1500 word report (50%) and data analysis (50%).

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BIOL5344: Programming in R (Required for QMBCE, CMAE; option for MRES*; 20 credits)

Course Coordinator: Dr. Richard Reeve (richard.reeve@glasgow.ac.uk)

*MRES students should check with their project supervisors, as taking this option would mean obtaining all taught credits in term 1

Course Aims: The aim of this course is to provide hands-on training in programming in the R environment, and teach students to use the data structures appropriately to solve problems.

Intended Learning Outcomes
With reference to the evidence base, by the end of this course students will be able to:
- Use appropriate data structures to retrieve and store information in R
- Select and justify the appropriate loops and program structures in R when solving a problem
- Use comments appropriately to explain program structure and design
- Write a document functions in R to carry out specified procedures
- Design simple computer programs to solve specified problems
- Write programs in R
- Generate reports in R where code is run and the output is discussed

Assessment: Students will write submit annotated code and reports generated in R from small assignments during the module, reflecting participation and competencies learned in practical computer laboratories (50%). The remaining 50% will be based on an independent assignment studied during last day of class and completed after the module that will require integration of the evidence-based knowledge and skills learned, involving direct application of programming skills obtained.

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Term 2 Courses (all 10 credits):

BIOL5114: Animal Ethics (Required for AWSEL; option for QMBCE, CMAE, MRES)

Course Coordinator: Dr. Dorothy McKeegan (dorothy.mckeegan@glasgow.ac.uk)

Course Aims: The aim of the course is to provide students with an awareness of the principles of relevant animal ethics frameworks and how these may be applied to consider the moral implications of different forms of human use of animals.

Intended Learning Outcomes
By the end of this course students will be able to:
- Recognise, evaluate and critically discuss the whole range of relevant animal ethics frameworks. Discuss critically with reference to the primary literature the tools to be used to recognise and reflect on ethical questions relating to the different human uses of animals and apply ethical reasoning to the main controversial issues in animal ethics
- Critically discuss, evaluate and synthesise welfare and ethical issues relating to different forms of human use of animals, contrasting our treatment of animals in different contexts where appropriate
- Critically analyse ethical dilemmas, employing ethical reasoning and applying ethical principles in the context of relevant case examples

Assessment: Students will produce an oral presentation based on a welfare issue in which they explore different ethical perspectives and their own view (50%). They will also write an essay (2000 words) that critically reflects on their own ethical position and its evolution (50%).

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BIOL5132: Biodiversity Informatics (option for QMBCE, CMAE, MRES, EIDAR)

Course Coordinator: Prof. Rod Page (rod.page@glasgow.ac.uk)

Course Aims: To provide evidence-based advanced practical training in using web services to aggregate and visualise biodiversity data, using an interactive and open-access based approach.

Intended Learning Outcomes
By the end of this course students will be able to:
- demonstrate advanced competence in querying biodiversity databases and be able to critically discuss with respect to the primary literature their most appropriate uses
- critically discuss with respect to the literature the strengths and limitations of existing biodiversity databases
- consider a biological question related to biodiversity informatics and take an evidence-based approach to determine which current databases and services are relevant to answering that question

Assessment: Students will submit practical exercises to gauge their depth of understanding and engagement with the skills learned in each of the practical sessions. The work will be assessed not only on completion of the assigned tasks but on interpretation and self-reflection of the theories learned (25%). The remaining 75% will be based on a set exercise that tests the practical skills and theories learned.

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BIOL5117: Biology of Suffering (option for AWSEL, QMBCE, CMAE, MRES)

Course Coordinator: Dr Dorothy McKeegan (dorothy.mckeegan@glasgow.ac.uk)

Course Aims: The aim of the course is to provide students with an advanced understanding of sentience and suffering in animals and how this relates to ethical and legal considerations.

Intended Learning Outcomes

By the end of this course students will be able to:

- Discuss critically the challenges faced by welfare research that aims to assess animal subjective states, and the strengths and weaknesses of different approaches
- Discuss critically the physiological basis of the stress response, the latest methodological developments on how to measure stress, and how these can inform welfare research
- Demonstrate detailed knowledge and critical understanding of the physiological basis of pain, discuss its evolution in the animal kingdom, and be informed by the developments at the forefront of pain research
- Apply knowledge and synthetic understanding of pain and stress to critically reflect on ethical issues and legislation
- Discuss critically the principles and concepts of disturbance and a critical awareness of its impacts on captive and wild animals

Assessment: Students will prepare an essay (2000 words; 100% of the course grade) where they will critically discuss current scientifc evidence for different types of animal suffering.

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BIOL5333: Care and Enrichment of Captive Animals (option for AWSEL, QMBCE, CMAE, MRES)

Course Coordinator: *Dr. Ruedi Nager (*ruedi.nager@glasgow.ac.uk*)*

Course Aims: The aim of the course is to provide students with a critical awareness of issues relating to care for captive animals, relate these to legislation and welfare science, understanding of the underlying principles that will guide enrichment and the design of enclosures and encourages students to creatively think about their own solution to welfare issues.***Intended Learning Outcomes***

By the end of this course students will be able to critically describe with respect to the primary literature:

- Critically describe animal welfare issues related to keeping animals in captivity with respect to the primary literature:
- The theories and principles underlying the design of animal husbandry approaches.
- The importance of genetic considerations and apply these principles to captive breeding.
- The techniques available to assess the health status of captive animals
- The relevant key enrichment pathways and ability to critically evaluate choice of enrichment options appropriate to a given problem,
- How enrichment and enclosure design impacts on the animal's welfare.
- Key issues in environmental enrichment for animal welfare, with respect to home office and EU requirements
- Latest developments in research on environmental enrichment
- Principles of welfare in the design of novel animal enclosures/cages/animal research facilities

Assessment: The assessment for this course will be a written planning document (100% of the course grade) on designing an animal research facility OR an enrichment programme based on the latest animal welfare science studies and relevant legislation (2000 words).

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BIOL5130: Conservation Genetics (option for all programmes)

Course Coordinator: Prof. Barbara Mable (Barbara.mable@glasgow.ac.uk)

Course Aims: To provide practical training in and the theoretical basis for basic molecular analyses used for identification and characterising of biodiversity, as applied to problems in the assessment of biodiversity, including approaches to DNA barcoding for identification and population genetics analyses of population structure and genetic history at a level sufficient to perform independent analysis of real datasets. The course will also highlight recent advances in

sequencing technology and approaches to genotyping, along with the new challenges that this will bring for analytical approaches.

Intended Learning Outcomes

By the end of this course students will demonstrate competence, be able to critically discuss the underpinning theoretical background, and provide an evidence-based justification to choose the most appropriate methods to apply to particular research questions related to:

- Basic manipulation of sequence and genotyping data using appropriate specialised software and interpretion of the patterns
- Use of specialised computer programmes for analysing molecular data to address research problems in biodiversity and conservation

In addition, students will be able to critically discuss in depth with respect to literature:

- The history of development of molecular techniques used in biodiversity research and the future changes that will come with continuing advances in sequencing and genotyping technology
- The scope and limitations of the range of analytical methods used to assess biodiversity through identification
- The theoretical basis behind the range of analytical methods available to infer population structure and genetic history using population genetics approaches

Assessment: Students will submit practical exercises to gauge their depth of understanding and engagement with the skills learned in each of the practical sessions. The work will be assessed not only on completion of the assigned tasks but on interpretation and self-reflection of the theories learned (40%). The remaining 60% will be based on an independent and evidence-based assignment (1500-2000 words) that will require integration of the knowledge and skills learned across the range of method and theories, including analytical approaches and interpretation of results in the context of the primary literature.

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BIOL5325: Economic Tools for Conservation (option for CMAE, QMBCE, MRES, AWSEL)*

Course Coordinator: Prof. Nick Hanley (nicholas.hanley@glasgow.ac.uk)

*This course is incompatible with BIOL5125

Course Aims: This course introduces masters students to concepts within environmental economics which are useful for analysing and designing conservation policies globally. No prior understanding of economics is necessary. Economics has a number of important insights which it can offer to the design and analysis of conservation policy. For example, how to identify the most cost-effective ways to achieve biodiversity targets; how to measure the willingness of people to fund conservation actions; and how to design payment for ecosystem services which effectively deliver environmental benefits. This new course introduces students to these insights, and to the economic tools which can be used to undertake policy analysis and policy design. We will also make students aware of the considerable empirical literature now available which illustrates the application of these tools in a range of contexts globally.

Intended Learning Outcomes

By the end of this course students will be able to:

- Critically discuss and evaluate concepts such as cost-effectiveness, cost-benefit analysis and payment for ecosystem service (PES) schemes, with reference to the evidence base and to economic theory
- Critically compare and contrast alternative design options for nature conservation policies on private land;

- Critically discuss ideas of economic efficiency, benefits and costs as tools for analysing conservation problems in a wide range of global settings
- Conduct economic analysis of specific examples of conservation policy
- Explain the results of such analysis to non-specialists, the policy community and other relevant stakeholders

Assessment: Students will write one essay of 3000 words maximum length on one of 3 questions set at the beginning of the course, based on a set of references provided and their own in-depth search of the literature (60% of assessment). They will also produce two "policy briefing reports" written on the basis of group discussions during the tutorial sessions and their own individual work for (i) design of PES schemes (ii) use of choice modelling to inform PES scheme design. These reports will be written in non-technical language and be of no more than 500 words in length, supported by at least one Figure. Each report will be worth 20% of the total assessment.

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BIOL5327: Epidemiology of Antimicrobial Resistance (Required for EIDAR)

Course Coordinator: Dr. Tiziana Lembo (tiziana.lembo@glasgow.ac.uk)

Course Aims: The aims of the course are to: provide a foundation of knowledge on the processes driving antimicrobial resistance emergence, persistence, transmission and spread at local, national, regional and global levels; familiarise the students with approaches available to detect and measure antimicrobial resistance in human and animal populations, and the environment; provide the students with the knowledge and skills to appropriately design an epidemiological study focusing on anti-microbial resistance; and equip the students with an understanding of appropriate interventions for preventing or reducing antimicrobial resistance threats in human and animal populations.

Intended Learning Outcomes
Knowledge and Understanding – Upon completion of the course, the students will be able to:
- Critically identify and explain with reference to the primary literature epidemiological processes relevant to infectious diseases, with a focus on antimicrobial resistance in a global context.
- Critically discuss with reference to the primary literature best practices in detection, measurement and analyses relating to antimicrobial resistance.
- Discuss in-depth relevant methods, and critically evaluate choice of methods appropriate to a given epidemiological investigation, set in the context of up-to-date primary literature in the field of antimicrobial resistance.
- Assimilate and evaluate mechanisms for the design, implementation and evaluation of interventions for the prevention and control of antimicrobial resistance in a range of populations.

Skills and Other Attributes – Upon completion of the course, the students will be able to:
- Critically research and synthesise scientific literature in order to recognise knowledge gaps and research priorities.
- Formulate research hypotheses or questions and evaluate study design options to address them.
- Discuss critically the value of interdisciplinary approaches to scientific learning, planning and execution.
- Reading and critical evaluation of scientific and non-scientific literature.
- Ability to articulate and communicate clearly and concisely the study subject both orally and in written form.
- Discuss the issues, opportunities and limitations of different types of study design methods and data.

Assessment: One written assignment (~1,500 words; 70%) and an oral presentation (30%).

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VETSCI5024: Genetic and Genomic Aspects of Antimicrobial Resistance (Required for EIDAR; Option for all other programmes)*

Course Coordinator: Dr. Katarina Oravcova (katarina.oravcova@glasgow.ac.uk)

*This course is incompatible with BIOL5137

Intended Learning Outcomes
Upon completion of the course, the students will be able to:
- Understand and critically discuss the molecular basis of emergence and spread of AMR
- Discuss and critically assess the use of genotypic and phenotypic approaches for AMR detection
- Explore and evaluate the role of genomics in the study of AMR
- Critically examine, analyse and summarise scientific literature on a chosen aspect of molecular mechanisms or genomic features of AMR
- Perform simple experiments on molecular identification of AMR determinants
- Comprehend and utilise selected tools for molecular and genomic screening of AMR
- Critically read and evaluate scientific literature
- Appraise and communicate a study subject in written and oral form
- Use software tools for molecular and genomic data analysis

Assessment: Students will submit one written assignment (1500 words) on genomic data analysis (50%) and a lab practical report (50%).

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BIOL 5250: GIS for Ecologists (option for MRES, CMAE, QMBCE)*

***Course Coordinator:* Dr. Roman Biek (roman.biek@glasgow.ac.uk)**

Course Instructor: Dr Colin Macleod (cdmacleod@GISinEcology.com)

* This course is space limited so instructor approval required

Course Aims: The aim of the course is to provide students with training in the collection and analysis of ecological data using a geographic information system (GIS). The objective is to develop key skills in creating a GIS using existing data and collecting suitable field data for an ecological project.

Intended Learning Outcomes
By the end of this course students will be able to: create a Geographic Information System (GIS) for an ecological research project and populate a GIS with existing data layers, data layers which they have created and with data collected in the field. In addition, students will be able to: (1) collect GIS compatible data in the field using a global positioning system (GPS) receiver, (2) setup and use a GPS receiver to record ecological field data (3) design a GIS project, and populate it with the required data to answer a specific research question.

***Assessment*:** Students will produce a GIS report displaying distribution maps, appropriate graphs and summary flow diagram based on collection of field data (60%). The remaining assessment will be a 1500 word review critically assessing the current use of GIS projects in specialised ecological research.

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BIOL5292: Human Dimensions of Conservation (Required for CMAE; option for AWSEL, QMBCE, CMAE, MRES)*

Course Coordinator: Prof. Sarah Cleaveland (sarah.cleaveland@glasgow.ac.uk)

* This course is space limited so instructor approval required

Course Aims: The course explores human dimensions of conservation, including topics relating to biodiversity conservation and human development, sustainable use, wildlife trade, hunting, human-wildlife conflict and wildlife interventions. These subjects will be considered from diverse ethical, ecological, socio-economic and political perspectives. The course will draw largely on examples from African ecosystems, but students will have opportunities to explore issues relevant to other parts of the world in facilitated discussions and as part of the practical exercise in media training.

Intended Learning Outcomes
By the end of this course students will be able to:
- Critically discuss with reference to the evidence base and primary literature:
  - Different approaches to natural resource management and their implications for biodiversity conservation and human development.
  - Interacting ecological, ethical, social and economic issues affecting conservation and the management of wildlife.
  - Challenges surrounding the sustainable utilisation of wildlife, including tourism, sport hunting and wildlife trade.
  - Dilemmas arising from human-wildlife conflict and different approaches to conflict mitigation.
  - Attitudes and approaches towards different types of wildlife interventions for conservation.
- Demonstrate a detailed understanding of a contemporary conservation dilemma.
- Make a rational argument for/against a particular conservation action/approach.

Assessment: Students will prepare a short piece of written work that addresses a contemporary conservation dilemma in the form of a press statement. This will form the basis of a media-style interview or presentation. Students will be assessed on their ability to summarise, synthesize and communicate key messages in a way that is accessible to a lay audience (50%). The remaining 50% will be based on a written exercise that will require integration of the evidence-based knowledge and skills learned in this module.

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BIOL5123: Infectious Disease Ecology & the Dynamics of Emerging Disease (option for QMBCE, CMAE)*

Course Coordinator: Prof. Louise Matthews (louise.matthews@glasgow.ac.uk)

* Prerequisite Programming in R

Course Aims: The aim of this course is to equip students with the mathematical and programming skills and theoretical background to be able to create simple epidemiological models, to interpret their outputs and to be able to critically evaluate published papers on infectious disease dynamics.

Intended Learning Outcomes
By the end of this course students will be able to critically discuss with respect to literature and theoretical background:
- The value of currently used standard epidemiological models
- The distinction between: frequency and density-dependent transmission; micro and macroparasite models
- The concept of herd immunity
- The principles behind standard vaccination strategies
- The distinction between and appropriate use of stochastic and deterministic formulations
- The definition and conceptual framework for the basic reproduction number
- The concept of critical community size
- The context for use of metapopulation models
- Impacts of host heterogeneity on infection dynamics
- The use of standard model types in the epidemiological literature

In addition, they will be able to:
- Program standard epidemiological models in R and interpret outputs
- Calculate the basic reproduction number for simple epidemiological models
- Identify and interpret equilibria in standard epidemiological models
- Generate a mathematical description of an infection dynamics model for a problem of their own choice

Assessment: Students will write submit annotated code and reports generated in R from small assignments during the module, reflecting participation and competencies learned in practical computer laboratories (50%). The remaining 50% will be independent assignment completed after the module that will require integration of the evidence-based knowledge and skills learned, involving direct application of programming skills obtained.

BIOL5124: Introduction to Bayesian Statistics (option for all other programmes)

Course Coordinator: Prof. Jason Matthiopoulos (Jason.matthiopoulous@glasgow.ac.uk)

Course Aims: The aim of the course is to provide the student with an evidence-based founding in the basic theory and practice of Bayesian statistics.

Intended Learning Outcomes
By the end of this course students will be able to critically discuss with reference to theory and practice:
- The key differences between a Bayesian and frequentist approach
- How prior information is used in a Bayesian approach
- The concept of Markov Chain Monte Carlo techniques
- The distinction between Metropolis-Hastings and Gibbs sampling

In addition, they will be able to:
- Write simple programs in WinBugs or JAGs
- Specify and discuss critically the appropriate use of both informative and 'uninformative' priors
- Identify when a model has converged
- Conduct model selection using DIC

Assessment: Students will submit practical exercises to gauge their depth of understanding and engagement with the skills learned in each of the practical sessions. The work will be assessed not only on completion of the assigned tasks but on interpretation and self-reflection of the theories learned (50%). The remaining 50% will be a take-home problem-based assignment that will require integration of the knowledge and skills learned in this module, in the analysis and discussion of an independent dataset.

BIOL5125: Invertebrate Identification (option for QMBCE, CMAE, MRES, AWSEL)*

Course Coordinator: Dr. Stewart White (stewart.white@glasgow.ac.uk)

*This course is incompatible with BIOL5325

Course Aims: The aim of this course is to provide students with in depth hands-on training to enable them to identify key vertebrate groups, using field guides, identification keys, and vocalizations, as required for assessment of biodiversity.

Intended Learning Outcomes
By the end of this course students will be able to take an evidence-based approach to:

- Identify species from key invertebrate groups, to the lowest taxonomic level possible for that group
- Use taxonomic keys and the principles behind them so that they can understand and implement the use of novel keys for groups that have not been studied directly in this course
- Understand and calculate biodiversity based on a range of indices and choose those most relevant to the taxa under study
- Consolidate the methodologies learned, in terms of an in-class laboratory test to evaluate their ability to use keys
- Devise and deploy an independent research assignment aimed at comparing trap efficiency, both qualitatively and quantitatively, and comparing levels of biodiversity in different habitat types in terms of species richness and abundance, which will require integration of knowledge learned in the core course Measuring Biodiversity and Abundance in the autumn term

Assessment: Students will submit practical exercises to gauge their depth of understanding and engagement with the skills learned in each of the practical sessions. The work will be assessed not only on completion of the assigned tasks but on interpretation and self reflection of the theories learned (20%), as well as demonstrating proficiency in identification through in-class tests (40%). Students will integrate knowledge learned in the preparation of an independent and evidence based assignment that will involve quantifying biodiversity in a sample obtained from either an aquatic or the terrestrial sampling course, and evaluating which measures of diversity are most appropriate for the taxonomic groups identified, for the particular habitat type sampled, as well as assessing which trapping techniques learned during the sampling modules are most efficient both qualitatively and quantitatively (40%).

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BIOL5127: Legislation & Societal Issues (Required for AWSEL; option for QMBCE, CMAE, MRES)

Course Coordinator: Dr. Ruedi Nager (ruedi.nager@glasgow.ac.uk)

Course Aims: The aim of the course is to provide students with a rigorous evidence-based understanding of key features of relevant legislation and societal issues regulating the use of animals in various contexts. Students will explore relevant legislation on a specific animal use issue of a country of their choice (ideally their home country).

Intended Learning Outcomes
By the end of this course students will be able to critically discuss with respect to the primary literature:
- Legislation concerning keeping animals in captivity in the UK and demonstrate a basic understanding of the UK legislative frameworks protecting animals in different contexts
- Key legislation relating to animal welfare in laboratory and zoo environments
- How societal influences affect discussion and public attitudes towards different forms of human use of animals, especially with respect to controversial issues
- How legislation is underpinned by ethical principles and results of current research in welfare science.
- Have a critical awareness how new policies are made and how the policy making process as well as the public may be influenced.

Assessment: Students will write a position paper essay (2000 words) on a chosen case study about an issue of animal use; the position paper should critically reflect on legislative, scientific and ethical aspects relevant to the chosen case, and come up with a clear conclusion on the student's position on the chosen case. This will comprise 50% of the mark. The remaining 50% will be based on a press release describing their views and rationale in their position paper to the general public.

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BIOL5119: Molecular Epidemiology and Phylodynamics (option for all programmes)

Course Coordinator: Dr. Roman Biek (roman.biek@glasgow.ac.uk)

Course Aims: To provide students with the conceptual background and hands-on training required for analysing and interpreting genetic data to answer applied questions in evolutionary biology and epidemiology, through the use of relevant specialised computer software and critical evaluation of the scientific literature.

Intended Learning Outcomes
By the end of this course students will be able to:
- Critically discuss with respect to the primary literature the use of various types of genetic data used in evolutionary analysis and epidemiology and their suitability for addressing specific research questions
- Conduct basic analyses on such data using contemporary software (including the program BEAST and others) and to diagnose and troubleshoot problems encountered during analysis
- Critically interpret and synthesise results of these analyses and make specific research and management recommendations on their basis with reference to the evidence base

Assessment: Students will submit practical exercises to gauge their depth of understanding and engagement with the skills learned in each of the practical sessions. The work will be assessed not only on completion of the assigned tasks but on interpretation and self reflection of the theories learned (40%). The remaining 60% will be based on a particular applied research problem in pathogen evolution and epidemiology for which the students are asked to analyse a provided data set using the tools learned in the course and write up a scientific report based on their findings (2000-3000 words).

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BIOL5131: Multi-species Models (option for all programmes)

Course Coordinator: Prof. Dan Haydon (Daniel.haydon@glasgow.ac.uk)

Course Aims: This course will introduce students to the theory and practice of formulating multi-species population models. It will aim to introduce students to the different ways these models can be formulated in theory, and implemented in practice (this will be undertaken in the R programming environment). Students will be asked to review a range of previous uses of these forms of models, and be asked to develop critical views of them. Emphasis will be placed on identifying the key assumptions of these different models, and when different formulations are most appropriate.

Intended Learning Outcomes
By the end of this course students will be able to discuss critically with respect to the evidence base and primary literature:
- Applications, limitations and assumptions of the main areas of multi-species population models
- Features of a range of commonly used multi-species population models, and evaluate the various assumptions that each make
- Examples of when these different models have been applied to particular situations, and what different sorts of predictions such models are most appropriate for
- Current issues and controversies in this area of multi-species ecological modelling

In addition, they will be able to:
- Implement a range of different multi-species models in R, and be able to conduct comprehensive numerical analysis of these models.
- Estimate critical parameters contained within these different formulations, and determine how the stability of these models depends on their formulation and parameterization.

Assessment: Students will submit practical exercises to gauge their depth of understanding and engagement with the skills learned in each of the practical sessions. The work will be assessed not only on completion of the assigned tasks but on interpretation and self-reflection of the theories learned (50%). The remaining 50% will be a set exercise that will require integration of the evidence-based knowledge and skills learned in this module.

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BIOL5293: Principles of Conservation Ecology (Required for CMAE; option for QMBCE, MRES, AWSEL)

Course Coordinator: Dr. Grant Hopcraft (grant.hopcraft@glasgow.ac.uk)

Course Aims: The course explores the interaction between species and environment in protected African ecosystems. It will examine the ecological factors and processes that underpin the abundance and spatial distribution of populations, and the dynamics of their within and between species interactions. It will be familiarise students with the key conceptual and quantitative paradigms relevant to conservation ecology the practice of conservation management, and the study and monitoring of components of African ecosystems. It will focus particularly on how to study and quantify ecosystem stress, and how ecological dynamics respond to stress and environmental change in African settings.

Intended Learning Outcomes
By the end of this course students will be able to:
- Identify and critically evaluate key concepts underpinning the interaction between species and their environments in protected African ecosystems
- Critically discuss the key ecological processes underlying the abundance and spatial distribution of species of conservation interest, and the conceptual and quantitative models that are used to characterise them
- Apply appropriate processes to measure and manage ecosystem stressors
- Critically discuss the ecological basis on which to build options for the management of natural resources and their implications for biodiversity conservation.
- Critically discuss and evaluate, with reference to the evidence base and primary literature, a particular conservation action/approach based on recognised ecological principles in order to make a rational argument for or against the action/approach
- Design management and research projects around sound and recognised ecological principles
- Appraise the usefulness of quantitative assessment of a given ecological process, and design processes for the acquisition of relevant quantitative data in conservation ecology.

Assessment: Engagement and application of theory during discussions: students will be assessed based on active participation in discussions and their ability to present, synthesise and engage with others about theories (30%). They will also be assessed on a set exercise that tests the practical skills learned (15%). Students will submit two drafts of a poster presentation that outlines their experimental plan for their independent research project (55%). This will incorporate the theories and practical lessons learned during the course and will help to develop their critical thinking skills for their projects. They will have the opportunity to improve their presentation based on formative feedback provided on the first draft.

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BIOL5294: Protected Area Management (Required for CMAE; option for QMBCE, MRES, AWSEL)*

Course Coordinator: Prof. Sarah Cleaveland (sarah.cleaveland@glasgow.ac.uk)

* This course is space limited so instructor approval required
Course Aims This course will introduce students to key issues in the management of protected areas in Africa, including the history of protected area management, legal and policy frameworks,

resource protection, ecological monitoring, fire management, tourism management and development, infrastructure management and community conservation. The course will draw largely on examples from African ecosystems, but students will be encouraged to contribute to facilitated discussions of conservation management in other parts of the world. Further topics will consider setting of conservation priorities, monitoring and evaluation of conservation actions, with emphasis on practical aspects of protected area planning.

Intended Learning Outcomes
By the end of this course students will be able to:
- Critically discuss and evaluate, with reference to the evidence base and primary literature, the key issues and activities involved in the management of terrestrial and marine ecosystems in Africa, including practical aspects of protected area planning.
- Critically discuss and evaluate, with reference to the evidence base and primary literature, approaches used in setting conservation priorities and the appropriate scales for conservation planning.
- Critically discuss contemporary controversies in relation to protected area management and different conservation paradigms.
- Develop an outline management plan for a protected area.
- Conduct a conservation priority-setting exercise

Assessment: The assessment will comprise a reflective writing exercise (30%) and an exercise that relates to conservation management of a protected area in Africa, comprising an oral presentation (30%) and written summary of an activity plan (40%). Students will be assessed on their ability to present and synthesize evidence and how they engage with others in discussing different approaches.

BIOL5135: Single-species Models (option for all programmes)

Course Coordinator: Dr. Jan Lindström (jan.lindstrom@glasgow.ac.uk)

Course Aims: This course will introduce students to the theory and practice of single-species population models. It will aim to introduce students to the different ways these models can be formulated in theory, and implemented in practice (this will be undertaken in the R programming environment). Students will be asked to review a range of previous uses of these forms of models, and be asked to develop critical views of them. Emphasis will be placed on identifying the key assumptions of these different models, and when different formulations are most appropriate.

Intended Learning Outcomes
By the end of this course students will be able to critically discuss with reference to the evidence base and primary literature:
- The applications, limitations and assumptions of the range of currently used single-species population models
- The key features of a range of commonly used single-species population models, and evaluate the various assumptions that each make
- Examples of when these different models have been applied to particular situations, and what different sorts of predictions such models are most appropriate for current issues and controversies in this area of ecological modelling

In addition, they will be able to:
- Implement a range of different single-species models in R, and be able to conduct comprehensive numerical analysis of these models
- Estimate critical parameters contained within these different formulations, and critically evaluate the sensitivity of model outputs to these parameters

Assessment: Students will submit practical exercises to gauge their depth of understanding and engagement with the skills learned in each of the practical sessions. The work will be assessed not

only on completion of the assigned tasks but on interpretation and self-reflection of the theories learned (30%). The remaining 70% will be a take home problem-based independent assignment that will require integration of the knowledge and skills learned in this course.

VETSCI5022: Societal Aspects of Antimicrobial Resistance (Required for EIDAR; option for all other programmes)

Course Coordinator: Dr. Katarina Oravkova (Katarina.oravkova@glasgow.ac.uk)

Course Aims: The overall aim of this course is to make students aware of societal aspects of AMR, and of the tensions that may exist between public and/or private good in the use of antimicrobials. Specifically, this course aims to:
- Explore ethical aspects of antimicrobial use for clinical purposes in animals;
- Familiarize students with regulation and legislation around antimicrobial use at national and international levels.
- Introduce students to conflicting interests and demands in society that influence antimicrobial use and restrictions on antimicrobial use.
- Enhance students' conceptual, analytical and intellectual skills.

Intended Learning Outcomes
By the end of this course students will be able to:
- Critically evaluate and debate the scientific basis and global health contexts of a specific aspect of the epidemiology of infectious diseases and antimicrobial resistance, using information obtained from critical appraisal of scientific literature;
- Critically evaluate and explain evidence and drivers underpinning policy documents, regulations and legislation regarding antimicrobial use at national or international level.
- Identify and debate ethical, professional, and societal issues raised by a specific aspect of the epidemiology of infectious diseases, i.e. AMR
- Critically appraise scientific data from the literature and integrate information from different sources
- Differentiate between evidenced based information, and policy or advocacy based information
- Critically analyse evidence base underpinning policy or legislation
- Demonstrate proficiency in oral communication of scientific evidence in the form of debate

Assessment: The summative assessment will consist of two written assignments
- 80% of the grade will be based on one written assignment (1500 words)
- 20% of the grade will be based on performance during a live debate (reassessments are not possible for this component)

BIOL 5129: Spatial Ecology (required for QMBCE; option for CMAE, MRES)

Course Coordinator: Prof. Jason Matthiopoulos (Jason.matthiopoulos@glasgow.ac.uk)

Additional Instructors: Dr. Grant Hopcraft (grant.hopcraft@glasgow.ac.uk), Dr. Luca Nelli (luca.nelli@glasgow.ac.uk)

Course Aims: This course will provide students with evidence-based core training in the fundamental concepts and quantitative tools used to estimate species distributions, habitat preferences and biodiversity patterns from field data. The main aim is to encourage students to think critically about the results of such analyses by highlighting the limitations of the current approaches and the contemporary primary literature that works to overcome them. All taught material will be demonstrated and consolidated with associated practicals in the programming language R.

Intended Learning Outcomes

By the end of this course students will be able to:
- Develop practical skills in the analysis of spatial data using R and associated libraries Develop practical skills in the manipulation of GIS data sets within the R statistical framework
- Develop practical skills in the analysis of species-habitat associations using statistical models
- Critically discuss with respect to the evidence base the relative merits of estimating maps of species abundance and the strengths and pitfalls of different methods used to achieve this
- Critically discuss with respect to the evidence base the challenges of developing and interpreting models of habitat preference
- Critically discuss with respect to the evidence base methods for quantifying habitat preference and the use for prediction of special abundance
- Critically discuss with respect to the evidence base techniques for importing and representing complex special data using geographic information systems
- Extrapolate their learning from individual practicals to an integration across subjects in the preparation of an independent final project

Assessment: Students will be assessed based on completion and accuracy of practical assignments that will be initiated in class and completed independently. The first of the 9 assessments will be formative (i.e. marked but not used for assessment). Each of the remaining 8 assessed practicals will contribute 7.5% of the final course mark. The remaining 40% will require students to integrate practical and lecture work with independent reading in the generation of an analytical report based on application of the methods learned, to a new dataset.

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BIOL5137: Vertebrate Identification (option for QMBCE, CMAE, MRES, AWSEL)*

Course Coordinator: Dr. Stewart White (stewart.white@glasgow.ac.uk)

*This course is incompatible with VETSCI15024

Course Aims: The aim of the course is to provide students with core evidence-based training in techniques for identifying key vertebrate groups, including bird songs and mammalian scats.

Intended Learning Outcomes
By the end of this course students will be able to take an evidence-based approach to:
- Identify species from key invertebrate groups, to the lowest taxonomic level possible for that group
- Use taxonomic keys and the principles behind them so that they can understand and implement the use of novel keys for groups that have not been studied directly in this course
- Understand and calculate biodiversity based on a range of indices and choose those most relevant to the taxa under study
- Consolidate the methodologies learned, in terms of an in-class laboratory test to evaluate their ability to use keys
- Devise and deploy a digital collection (i.e. photographs and/or bird songs) for which complete species descriptions are generated, such as would be found in a monograph describing a new species

Assessment: Students will submit practical exercises to gauge their depth of understanding and engagement with the skills learned in each of the practical sessions. The work will be assessed not only on completion of the assigned tasks but on interpretation and self-reflection of the theories learned (20%), as well as demonstrating proficiency in identification through in-class tests (40%). Students will integrate knowledge learned in the preparation of an independent and evidence-based assignment in the form of a monograph of species description or creation of a novel key (40%).

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Welfare Assessment (Required for AWSEL; option for QMBCE, CMAE, MRES)

Course Coordinator: Dr. Ruedi Nager (ruedi.nager@glasgow.ac.uk)

Course Aims: The aim of the course is to provide students with an evidence-based understanding of methods and techniques used to assess physiological state of wild animals and provide them with the competence to identify the health state of wild animals

Intended Learning Outcomes
By the end of this course students will be able to:
- Comprehensively discuss the relevance of concepts from behaviour and physiology to welfare assessment with reference to key literature
- Critically analyse, evaluate and synthesise methodologies and techniques that can be used to monitor the welfare state of captive and wild animals
- Demonstrate knowledge and critical awareness of what factors contribute to the wellbeing of individuals and populations

Assessment: Students will be assessed on a written essay on how a specific exhibit meets the animal's welfare requirement based on a formal welfare assessment taking place at one of the site visits The word count of the essay is 2000 words and contributes 100% to the mark.