



grupo de biodiversidade $\alpha\beta$ dos açores
<http://www.angra.uac.pt/gba>



FCAA
FACULDADE DE CIÊNCIAS
AGRÁRIAS E DO AMBIENTE
UNIVERSIDADE DOS AÇORES

SUMMER SCHOOL IN ISLAND BIOGEOGRAPHY AND MACROECOLOGY 2023 EDITION

DETAILED PROGRAM

Calendar:

July 17th to 28th 2023

Duration: 70 hours (6 ECTS)

Venue: Campus of the Faculdade de Ciências Agrárias e do Ambiente (FCAA) Angra do Heroísmo, Terceira Island, in the Azores Archipelago, PORTUGAL

Lecturers:

Organizing committee

(all from the University of Azores, FCAA – Faculdade de Ciências Agrárias e do Ambiente / Azorean Biodiversity Group, cE3c)

- Paulo A. V. Borges
- Rosalina Gabriel
- Rui Bento Elias,
- Isabel R. Amorim,
- Mário Boeiro,

- Gabor Pozsgai,
- Noelline Tsafack

Invited Scientists:

Week 1

- François Rigal (University of Pau, France)
- Robert J. Whittaker (University of Oxford, England, U.K.)
- Simone Fattorini (University of L'Aquila, Italy)
- Ana Santos (Universidade Universidad Autónoma de Madrid, Spain)

Week 2

- Brent Emerson (Island Ecology and Evolution Res. Group-IPNA-CSIC, Canary Islands, Spain)
- Joaquin Hortal (Natural History Museum in Madrid (MNCN), Spain)
- Luís Borda-de-Água (CIBIO -Porto, Portugal)
- Pedro Cardoso (Natural History Museum, University of Helsinki, Finland)
- Rosemary Gillespie (University of California, Berkeley, USA)

Course description:

The 'Summer School in Island Biogeography and Macroecology', is a comprehensive course offering an overview of different island biogeography and macroecological topics focused on terrestrial ecosystems. It offers not only a strong theoretical background, presented by some of the most prestigious scientists in the field, but also innovative methodologies, regarding field sampling and analytical tools. During the two-week course the students will follow all the steps of a scientific project, from developing research questions objectives and hypotheses, to the selection of methods, including the collection, analysis and discussion of data/results. There will also be ample opportunity to discuss student's own data and case studies.

The course is focused on the large-scale patterns of taxonomic, phylogenetic and functional diversity.

Specific theoretical topics will be:

- (1) Ecological/evolutionary theories developed from studies on islands, and their applications in other research areas;
- (2) Processes that occur during and after island colonization, that shape island communities;
- (3) Island community-assembly rules;
- (4) Island evolutionary processes;
- (5) Applications of island biogeography to conservation biology;
- (6) Islands within islands - caves/lava tubes; kipukas
- (7) Island paleobiogeography.

Specific applied practical topics will be:

- (1) Quantification of alpha, beta and gamma diversity;
- (2) Quantification of rarity and species abundance distribution;
- (3) Estimating diversity from incomplete sampling;
- (4) Standardize sampling protocols for island fauna and flora surveys and monitoring;
- (5) Biological traits in ecology and conservation
- (6) Network ecology modelling;
- (7) Population genetics/genomics
- (8) Phylogenetic analysis and phylogeography
- (9) Phylogenetic and functional diversity (richness, dispersion, evenness)
- (10) Partitioning taxonomic, phylogenetic and functional beta diversity;

Duration: 70 hours (6 ECTS)

Schedule: 9h-12h30 and 14h00-17h30 Monday to Friday

	Monday, 17	Tuesday, 18	Wednesday, 19	Thursday, 20	Friday, 21 and Sunday 23
9h-12h30 15 m for coffee break	Opening session Theoretical Class 1 Paulo A. V. Borges Theoretical Class 2 Robert J. Whittaker	Theoretical Class 5&6 Ana Santos	Theoretical Class 9 François Rigal Practical's François Rigal	Theoretical Class 10 & 11 Simone Fattorini	Field trip Rui B. Elias; Rosalina Gabriel
12h30-14h00	Lunch	Lunch	Lunch	Lunch	Field trip Lunch
14h00-15h30 15 m for coffee break	Theoretical Class 3 Robert J. Whittaker	Theoretical Class 7 François Rigal	Practical's François Rigal	Theoretical 12.1 Paulo Borges Theoretical 12.2 Gabor Pozsgai	Field trip Paulo A.V. Borges S. Fattorini Mário Boeiro Isabel R. Amorim
15h45-17h30	Theoretical Class 4 Robert J. Whittaker	Theoretical Class 8 François Rigal	Practical's François Rigal	Practical's Gabor Pozsgai P	Field trip Mário Boeiro Gabor Pozsgai
17h30-18h30	Students interactions with teachers WELCOME RECEPTION	Students interactions with teachers	Students interactions with teachers	Students interactions with teachers	
	Monday, 24	Tuesday, 25	Wednesday, 26	Thursday, 27	Friday, 28
9h-12h30 15 m for coffee break	Theoretical Class 13&14 Joaquin Hortal	Theoretical-Practical's Pedro Cardoso Paulo Borges	Theoretical Class 18&19 Brent Emerson	Theoretical Class 21&22 Rosemary Gillespie	Project presentation 1 Rosalina Gabriel et al.
12h30-14h00	Lunch	Lunch	Lunch	Lunch	Lunch
14h00-15h30 15 m for coffee break	Theoretical Class 15 Joaquin Hortal	Theoretical Class 17 Luís Borda-de-Água	Theoretical Class 20 Brent Emerson	Theoretical Class 23 Rosemary Gillespie	Project presentation 2 Rosalina Gabriel et al.
15h45-17h30	Theoretical Class 16 Joaquin Hortal	Practical's Luís Borda-de-Água Paulo A. V. Borges	Practical's Pedro Cardoso Paulo Borges	Practical's Pedro Cardoso	Project presentation 3 Rosalina Gabriel et al.
17h30-18h30	Students interactions with teachers	Students interactions with teachers	Students interactions with teachers	Course-dinner	

CLASS ABSTRACTS

WEEK 1

PAULO A.V. BORGES (Monday, 18th)

-Overview of the Course

Session 1-Long-term ecological studies in Azores overview: a summary perspective

Important Links

https://bdj.pensoft.net/topical_collection/58/

<https://azoresbioportal.uac.pt/>

<http://www.maiisg.com/>

ROBERT J. WHITTAKER (Monday, 18th)

Session 2 Introduction to island biogeography

A brief overview of the importance of islands as model systems in the development of ideas in ecology, evolution and biogeography; types of islands and the significance of island origins and dynamics; introduction to filters, island assembly filters and syndromes; island endemism.

Session 3 - Insular macroecology and the equilibrium theory

In this session we will re-acquaint ourselves with the Equilibrium Theory of Island Biogeography and will consider its relevance to understanding insular species-area relationships (ISARs); the shape of the ISAR; 'best' model of the ISAR; scale dependency and parameters of the ISAR.

Session 4 - Island biodynamics in response to island geodynamics

We will examine the development of the General Dynamic Model (GDM) of oceanic island biogeography; empirical tests and simulation models; what next?

Key reading for Sessions 2, 3 and 4

I am providing four articles, but if you have time to read only two, then read the first two for the background provided in terms of the ideas covered. If you know them well already, there are two further, more recent articles that bring us further into the topics.

1 MacArthur and Wilson (1963) An equilibrium theory of insular zoogeography. *Evolution*, 17, 373-387.

[The equilibrium theory has had a profound influence on the subject of island biogeography and it is important to go back to the original text from time to time and to (re-)acquaint ourselves with what they original wrote. Relevant to the entire course!]

2 Whittaker, R. J., Triantis, K.A. and Ladle, R.J. (2008) A general dynamic theory of oceanic island biogeography. *Journal of Biogeography*, 35, 977-994.

*[Apologies that this and the next two are from my own collaborations. Not quite the first paper we wrote on this topic (there was a 2007 article in *Ecography*, but this was the paper that laid out, developed and named the full GDM theory. Relevant to session 3]*

3 Whittaker, R.J., Fernández-Palacios, J.M., Matthews, T.J., Borregaard, M.K., & Triantis, K.A. (2017) Island Biogeography: taking the long view of nature's laboratories. *Science*, 357, eaam8326.

[Summarizes a lot of our thinking in the concise format of a Science review paper. We will cover most of this within the three sessions]

4 Matthews, T. J., Rigal, F., Triantis, K.A. & Whittaker, R.J. (2019) A global model of island species–area relationships. *Proceedings of the National Academy of Sciences, USA*, 116 (25), 12337–12342.

[I was and remain excited by this paper, as working on it helped me understand the island species-area relationship in a deeper way. But have we managed to persuade others of this? This is relevant to the second session]

ANA M. C. SANTOS (Tuesday, 19th)

Session 1 Arrival and Change (1.5 hours)

Dispersal and colonization; dispersal syndromes. Ecological responses to empty niche space; niche shifts, ecological release, density compensation. Island syndromes; changes in body size, changes in dispersal ability, etc.

Session 2 Assembly of island communities (45 minutes)

Assemblage processes; assembly rules. Assemblage characteristics; disharmony, filters, generalism.

Session 3 Assembly of island communities (45 minutes)

Main threats to island biodiversity: land-use changes, species introduction, climate change, diseases. Examples of conservation initiatives

FRANÇOIS RIGAL (Tuesday, 19th and Wednesday, 20th)

- Conceptual bases of functional approaches in community ecology
- Computing functional diversity (overview of the different indices and different R packages available and introduction to null models)

SIMONE FATTORINI (Wednesday, 20th)

Session 1 Applications of island biogeography principles to conservation biology (1.5 hours).

Area, shape, isolation, and environmental heterogeneity. SLOSS (Single Large Or Several Small) debate. Use of the species-area relationship in conservation. Species extinction and extinction debt. Co-occurrence. Nestedness calculation and conservation issues.

Session 2 - Habitat islands – urban parks, caves, freshwater environments, and sky islands (1.5 hours).

Forms of isolates. Hosts as islands for parasites. Fragmentation and metapopulations. Role of urban green spaces in conservation biology and application of ETIB principles. Island biogeography of subterranean environments. Lakes and springs as islands. Sky-islands, mountain tops and climate change.

PAULO BORGES, (Thursday, 21st)

- Biodiversity Data Bases and data Sharing- Darwin CORE - GBIF

GABOR POZSGAI, (Thursday, 21st)

- Network ecology modelling

FIELD TRIP TOPICS (Friday, 22nd)

RUI BENTO ELIAS

- Vegetation of Azores
- Standardized methods for sampling vegetation

ROSALINA GABRIEL

- Byoflora of Azores
- Standardized methods for sampling Bryophytes (MOVECLIM protocol)

PAULO A.V. BORGES

- Standardized methods for sampling arthropods (BALA and COBRA protocols)

MÁRIO BOIEIRO

-- Standardized methods for sampling pollinators

WEEK TWO

JOAQUIN HORTAL (Monday, 24th)

Session 1 Measures of species diversity

Facets of biodiversity. Species diversity: richness, composition, beta diversity (replacement and nestedness), rarity and endemism. Genetic and ecological diversity. Abundance and evenness. Stratification of biodiversity data.

Session 2 Using biodiversity data: issues of quality, quantity and bias)

Types of distributional data. Databases and biodiversity Information Systems. Main shortfalls in biodiversity data. Assessing data quality and bias. Sampling effort evaluation. Data-driven uncertainty and maps of biogeographical ignorance.

PEDRO CARDOSO, PAULO A. V. BORGES (Tuesday 25th)

Session 1- Estimation of taxonomic, phylogenetic and functional richness from incomplete sampling (theoretical)

Tuesday, 26 (9h-10h30) Pedro Cardoso, Paulo Borges, Joaquín Hortal

Curve-fitting estimators. Non-parametric estimators. Tree-based estimators. Case-studies in R.

Session 2- Dispersion, evenness, and beta-diversity (theoretical)

Tuesday, 26 (10h45-12h30) Pedro Cardoso, Paulo Borges, Joaquín Hortal

Taxonomic, phylogenetic, and functional dispersion. Taxonomic, phylogenetic, and functional evenness. Taxonomic, phylogenetic, and functional beta diversity. Partitioning beta diversity in replacement and richness differences. Case-studies in R.

LUIS BORDA DE-ÁGUA, PAULO A.V. BORGES (Tuesday 25th)

- Neutral theory of biodiversity
- Quantification of rarity and species abundance distribution

PEDRO CARDOSO (Wednesday, 26th and Thursday 27th)

Session 3- Estimation of taxonomic, phylogenetic and functional richness from incomplete sampling (practical)

Wednesday, 27 (15h45-17h30) Pedro Cardoso, Paulo Borges

Create your own data. Sampling curves. Quantifying sampling effort. Non-parametric estimators. Bring your own data.

Session 4 - Dispersion, evenness, and beta-diversity (practical)

Thursday, 28 (15h45-17h30) Pedro Cardoso, Noelline Tsafack

Create your own data. Taxonomic, phylogenetic, and functional dispersion and evenness. Taxonomic, phylogenetic, and functional beta diversity and partition. Bring your own data.

BRENT EMERSON (Wednesday, 26th)

(Session 1) Barcoding and metabarcoding for arthropod island biogeography and macroecology at scale (1.5 hrs)

Basic principles of barcoding. Barcoding for species assignment. Barcoding opportunities and limitations. Integrating barcoding into ecological sampling. Barcoding for phylogeographic inference. Basic principles of metabarcoding. eDNA vs wocDNA. wocDNA metabarcoding to advance island biology, and a forward look at arthropod metabarcoding on islands.

(Session 2) Evolutionary process on islands – pathways to arthropod island endemism (1.5 hrs)

Paradigm evolutionary insights from islands. Challenges and opportunities to study arthropod evolution on islands. Species concepts and speciation. Macroevolution, microevolution, and

unified approaches in islands. Genetics, genomics, the state of the art in island arthropods, and a forward look at arthropod evolutionary analysis on islands

(Session 3) Topography, climate, dispersal ability, their interaction, and arthropod community assembly (1.5 hrs)

Topography and climate in space, niche landscapes. Climate history and niche landscapes through time. Species niche and species dispersal ability. Community assembly concepts. Genetics, genomics, the state of the art in arthropod community assembly analysis on islands. A forward look at arthropod community assembly on islands.

ROSEMARY GILLESPIE (Thursday, 27th)

Session 1. Reconstructing species divergence in a geographic context:

- Speciation mechanisms:
 - Allopatric –
 - Vicariance and dispersal; interplay and significance
 - Parapatric – different areas and selective pressures
 - Sympatric (if it happens at all)
 - Founder events and evolutionary bottlenecks
- Reconstructing evolutionary history
- Phylogenetic systematics - Cladistics
 - Morphological
 - Molecular
 - Need for fossils
- Phylogeography
- Biogeographic reconstruction
 - Nested clade analysis, Biogeobears, Structure

Session 2 - Adaptive radiation

- Role of isolation in adaptive radiation
- Radiation zone & association with dispersal
 - Mammals – Philippines
 - Frogs – Melanesia
 - Arthropods & birds – most remote
 - Marine organisms vs terrestrial etc.
- Community context of adaptive radiation and extinction - community phylogenetics (building on where Brent leaves off?). Focus in on (1) phylogenetic + phenotypic overdispersion.
- Early stage diversification, eg in sticklebacks
- Non adaptive radiation, esp in some island birds and snails

- Adaptive radiation associated with environmental shifts
- Adaptive radiation associated with niche shifts within an environment
- Role of hybridization, hybrid swarms

Session 3 . Community context of adaptive radiation

- Diversity through time – hotspot islands; specialization
- Priority effects
- Convergence and parallelism
- Levels of endemism and rates of extinction in islands
- Invasive species; biotic homogenization
- Biotic resilience and vulnerability

ROSALINA GABRIEL, ANA M. C. SANTOS, JOAQUIN HORTAL, LUIS BORDA-DE-ÁGUA, PAULO A. V. BORGES, PEDRO CARDOSO, ROSEMARY GILLESPIE, (Friday, 28th)

-Students projects presentation and discussion

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