

CONGRESS – ECOLOGY AT THE INTERFACE – 21-25 SEPTEMBER 2015 ROME
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Proposal for a Symposium

ISLAND AT THE CROSSROADS: CONSERVATION DILEMMAS UNDER GLOBAL CHANGES

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Aims

Islands are well recognized as fascinating natural laboratories for the study of ecological patterns and processes. Island systems have a leading role in supporting a bulk of theories in the fields of community ecology, biogeography and evolution. However, islands are also known by their susceptibility to species invasions and have a disproportionate share of the world's rare, endemic, threatened and extinct species. Climatic changes, land degradation and other human mediated environmental transformations will have an impact of still unknown consequences for islands' biodiversity and sustainable development.

This symposium aims to present case studies of world relevance on the impact of several global changes at local and regional scales on oceanic island systems. In addition we aim to attract talks that explore the following general topics: control and management of invasive species; tackling biodiversity loss in islands under climatic changes and building resilience strategies; macroecological studies on islands leading to unified models of islands ecology and biogeography; human effects on evolutionary processes in island organisms.

Finally, we aim to improve and enlarge existing long-term island research networks based on relevant and motivated research actions and other joint activities.

SUMMARY (400 Characters)

Islands are well recognized as fascinating natural laboratories for the study of ecological patterns and processes. This symposium aims to present case studies of world relevance on the impact of several global changes at local and regional scales on oceanic island systems. Finally, we aim to improve and enlarge existing long-term island research networks based on relevant and motivated research actions and other joint activities.

Proponents

Paulo A. V. Borges (CE3C, Azorean Biodiversity Group, Univ Azores)

Convener bio-sketch

Paulo A. V. Borges has a Ph.D. in Insect Ecology by the University of London (Imperial College; 1997) and is currently leading the Azorean Biodiversity Group (CITA-A) within the University of the Azores (<http://www.gba.uac.pt/>). His research interests focus on the study of Biodiversity of Azorean Arthropods, with emphasis on taxonomy, ecology (Macroecology), biospeleology and biogeography. He is also interested on: (i) the development of species-area models that could describe patterns of species richness and potential extinction on islands; (ii) empirical modelling of species distributions at different scales; (iii) analysis of processes affecting patterns of species richness of arthropods at different spatial scales.

Simone Fattorini (CE3C, Azorean Biodiversity Group, Rome)

Convener bio-sketch

Simone Fattorini is an evolutionary biologist with broad interests, involving insect biogeography, ecology and conservation in island, coastal and urban ecosystems. He is also interested in the study of vertebrate and invertebrate macroecological patterns. He has taught Applied Ecology at "Roma Tre" University and he has worked at the Italian Agency for the Environmental Protection (now ISPRA).

His current research projects include: (1) Identification of priority areas for invertebrate conservation; (2) Analysis of ecological and paleogeographical factors determining faunal patterns on islands; (3) Factors responsible for animal community organization

and evolutionary dynamics at microsite scale; (4) Analysis of large scale biodiversity patterns of terrestrial and marine animals; (5) Evolutionary biology of parasitism

Confirmed participants

Leading Presentations (30 m each)

-Paulo A. V. Borges (CE3C, Azorean Biodiversity Group, Univ Azores) – “CROSS ARCHIPELAGOS BIODIVERSITY STUDIES: SADS AND SARS”

Convener bio-sketch

Paulo A. V. Borges has a Ph.D. in Insect Ecology by the University of London (Imperial College; 1997) and is currently leading the Azorean Biodiversity Group (CITA-A) within the University of the Azores (<http://www.gba.uac.pt/>). His research interests focuses on the study of Biodiversity of Azorean Arthropods, with emphasis on taxonomy, ecology (Macroecology), biospeleology and biogeography. He is also interested on: (i) the development of species-area models that could describe patterns of species richness and potential extinction on islands; (ii) empirical modelling of species distributions at different scales; (iii) analysis of processes affecting patterns of species richness of arthropods at different spatial scales.

Summary of the presentation

Island biogeographical and ecological theories are dominated by patterns and processes related with species diversity. We have some understanding about processes of species diversification and the roles of area, habitat diversity and island age on species richness on islands. However, there is no theory relating island geographical variables with species abundance and community assembly. In this contribution we use standardized arthropod and vascular plant datasets from the Azores, Madeira, Canary Islands and La Reunion to investigate the impact of habitat (land-use) island characteristics on species abundance distributions (SADs). We found that in the Azores a large number of communities are bimodal, comprising a mode of very rare species and a mode of relatively common species, the rarer mode containing a higher proportion of satellite taxa, introduced species and species that are more adapted to anthropogenic land uses surrounding native forests. We also found that SADs change as a function of sample size, or in other words to their scaling properties. From this

respect, island species composition is more important than trophic groups in the properties of SADS. Consistent differences in the shape and parameters of SAD models demonstrate that their study is potentially useful for biogeographical purposes.

-Simone Fattorini (CE3C, Azorean Biodiversity Group, Rome) – “INSECTS AND THE CITY: WHAT ISLAND BIOGEOGRAPHY TELLS US ABOUT INSECT CONSERVATION IN URBAN AREAS”

Convener bio-sketch

Simone Fattorini is an evolutionary biologist with broad interests, involving insect biogeography, ecology and conservation in island, coastal and urban ecosystems. He is also interested in the study of vertebrate and invertebrate macroecological patterns. He has taught Applied Ecology at “Roma Tre” University and he has worked at the Italian Agency for the Environmental Protection (now ISPRA).

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Summary of the presentation

Habitat fragmentation determined by urbanization is considered a prominent threat to biodiversity. Urban development creates a mosaic of natural fragments which can be occupied by organisms able to survive in small spaces. These fragments are a set of habitat islands separated by inhospitable environments. Because of their isolation, communities of urban green spaces can be investigated using hypotheses developed in island biogeography. The “equilibrium theory of island biogeography” (ETIB) allows the formulation of some predictions about how various characteristics of green spaces (such as their area, shape, level of isolation, environmental heterogeneity, age, etc.) should influence species richness. Many studies found supports for ETIB predictions, but results varied considerably according to the species’ sensitivity to patch size, matrix characteristics, and history of the city. In some cases ETIB predictions were falsified. These contrasting results warn against making generalizations on conservation strategies only based on ETIB models. On the other hand, the ETIB may represent a useful framework for urban conservation, especially for small animals like insects, if the role of other factors, such as the surrounding landscape, the specific needs of the

species under study, and the history of the urbanization process, are taken into account.

Eight Presentations of 15 m

1) -Rosalina Gabriel (CE3C, Azorean Biodiversity Group, Univ Azores) – “MOVECLIM – CROSS ARCHIPELAGO EVALUATION OF ALTITUDINAL PATTERNS IN BRYOPHYTES”

Convener bio-sketch

Rosalina Gabriel ongoing research focuses on two scientific areas: Bryology and Environmental Education.

In Bryology she is interested in: (i) the Inventory of bryophyte diversity in Macaronesia (mainly in the Azores); (ii) Macroecology and biogeography of bryophytes; (iii) Growth patterns of bryophytes and climatic variables; (iv) Ecophysiology of bryophytes (relationships with relative humidity, water, temperature, light); and (v) Bryophytes conservation, especially considering native habitats.

In Environmental Education, she is focused on: (i) the environmental perspectives and attitudes of the Azoreans in different populational groups (rural / urban; children / adults / aged); (ii) Environmental behaviours of the Azoreans (e.g. consumerism / recycling practices) and (iii) Environmental risk communication (e.g. urban pests / obesity).

Summary of the presentation

Bryophytes, such as mosses, liverworts and hornworts are able to colonize a vast number of substrates and occur in all terrestrial ecosystems, with a successful and long evolutionary history. Notwithstanding, bryophytes remain one of the least included groups of organisms in ecological or conservational studies. It is reasonably asserted that global change will impact Earth differently, with more threatening effects on the most vulnerable areas, such as islands, humid zones, forests or mountains. All these ecosystems need to be thoroughly investigated and model organisms, such as bryophytes, may contribute to the production of well-adjusted restoration and management plans. Project MOVECLIM (Montane vegetation as listening posts for climate change) investigated spatial changes in diversity of bryophytes and ferns along altitudinal transects in four oceanic (La Palma, La Réunion, Pico, Terceira) and one continental island (Madagascar); it addressed issues such as diversity and rarity patterns across elevation gradients and islands, community structure at different

spatial scales, and the relative contribution of different factors in shaping species richness distribution patterns. This project may contribute to the Aichi Biodiversity Targets, and to foster the understanding of community assemblages, scale effect and elevation shifts under a changing environment.

2) -Manuel Steinbauer (Department of Biogeography, BayCEER, University of Bayreuth Germany). -“WHAT DRIVES RICHNESS AND DIVERSIFICATION ON ISLANDS - ISOLATION VS. ENVIRONMENT”

Manuel J. Steinbauer is a scientist at the Section of Ecoinformatics & Biodiversity at Aarhus University, Denmark. His research interest is a quantification and understanding of causal drivers behind the geography of life. Manuel Steinbauer is thus investigating biogeographic patterns with particular focus on scale dependent patterns/processes, theoretical ecology, dispersal and isolated systems like island or mountains.

Preliminary summary of the presentation

Isolation is a fundamental driver of speciation, and thus biodiversity origination, yet is largely ignored when trying to explain elevational or latitudinal diversity gradient. Here I present results from a multi-author initiative covering entire floras of more than 30 high-elevation islands. We show a strong, globally consistent empirical relationship between elevation and endemism, indicating an effect of topography-driven isolation on speciation whose generality has hitherto been unrecognized. Isolation is locally more important than temperature, biotic interactions and area in influencing speciation rate, on both mountainous islands and continental mountains. We infer that isolation plays a more prominent role in generating diversity gradient than previously thought. This may even represent a mechanism to explain why there are so many terrestrial species overall, and also why they increase in number towards the equator. The study also demonstrates the potential of island systems for enhancing our theoretical understanding of nature.

3) - Michael K. Borregaard (Center for Macroecology, Evolution and Climate, National Museum of Natural History, University of Copenhagen Denmark) - “TOWARDS A CONSTITUTIVE THEORY OF ISLAND BIOGEOGRAPHY”

Convener bio-sketch

Michael Krabbe Borregaard is an assistant professor at the Center for Macroecology, Evolution and Climate. His research interests span from large-scale geographical ecology to island biogeography, and focuses on understanding the drivers of temporal

and spatial dynamics of species richness. He is especially interested in the interplay between ecology, evolution and geological processes in shaping biological patterns.

Summary of the presentation

Island biogeography focuses on understanding the processes that underlie a set of well-described patterns on islands, but lacks a unified theoretical framework for integrating these processes. The recently proposed General Dynamic Model (GDM) of oceanic island biogeography promises a step towards this goal. Here, we present a more formal analysis of causality within the GDM, and investigate its potential for the further development of island biogeographical theory. Further, we extend the GDM to include subduction-based island arcs and continental fragment islands.

4) - Jens M. Olesen (Department of Bioscience, Aarhus University, Denmark) - " THE BIOTIC INTERACTION STRUCTURE OF AN ISLAND LANDSCAPE, ESPECIALLY IN RELATION TO LINK MULTIPLICITY "

Olesen, J. M.¹, Damgaard, C. F.¹, Heleno R. H.², Nogales M.³, Vargas P.⁴; Trøjelsgaard, K.⁵ & Traveset A.⁶

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5, Department of Chemistry and Bioscience, Aalborg University

6, Institut Mediterrani d'Estudis Avançats (CSIC-UIB), Esporles, Balearic Islands, Spain

Convener bio-sketch

Jens M. Olesen is professor in ecology at Aarhus University in Denmark. His research area is ecological networks on islands. Networks are structures of species/individuals and their biotic interactions, which encompass both mutualistic (pollination, seed dispersal, facilitation) and antagonistic interactions (competition, predation, parasitism). He studies their structure and assembly during the ontogeny of islands. In addition, he analyses their stability and dependence upon underlying physical factors, such as volcanic eruption, erosion and sedimentation. This work is driven by a deeper

interest and engagement in the preservation of the unique island biota, which globally are highly threatened.

Summary of the presentation

Insects are, by far, the most species-rich and abundant group of animals in the world and accordingly, serve as a plentiful source of food to many other animals, e.g. more than half of all bird species have insects as their main diet component. This, however, turns into a problem on oceanic islands, which have relatively many insect-eating vertebrates but few insects. Thus to survive, these island insect-eaters must widen or change their food niche. This is often seen in small lizards, which on continents are dedicated insect eaters, but on islands relax their diet requirements by also consuming nectar, pollen and fruit pulp. Doing so, lizards become important pollinators and seed dispersers to many plants, which also suffer from this paucity of insects for their pollination. Many island lizards are even 'double mutualists', serving as both pollinators and seed dispersers and this is particularly so on remote oceanic islands, i.e. they show link multiplicity. Thus many insect-eating vertebrates, birds and reptiles, widen their niche on islands, and include plant food into their diet. However, the role of birds and reptiles as plant mutualists is still poorly known. In the Galápagos, we examined the role of land birds and reptiles as plant mutualists and in the talk, we will document this and compare with other archipelagos.

5) - Raluca Voda¹, **Leonardo Dapporto**^{1,2}, Vlad Dincă,^{1,3} Tim Shreeve² Paul Hebert³, Mourad Khaldi⁴, Ghania Barech⁴, Khellaf Rebbas⁴, Paul Sammut¹, Roger Vila¹ (1Butterfly Diversity & Evolution Lab, CSIC-Universitat Pompeu Fabra, Spain, 2Oxford Brookes University, UK, 3University of Guelph, Canada; 4University of M'Sila, Algeria) - "COMMUNITY STRUCTURE AND COMPLETE PHYLOGEOGRAPHY OF BUTTERFLIES FROM WESTERN CIRCUM-SICILIAN ISLANDS REVEAL BIOGEOGRAPHIC PROCESSES AND SELECTIVE LOSS OF DIVERSITY"

Convener bio-sketch

Members of the Butterfly Diversity and Evolution lab and the other members of the research team are actively engaged in insect biogeography, systematics and conservation, with specific interest in unravelling the historical and present-day factors responsible for species distributions across mainland Europe and Mediterranean islands.

Summary of the presentation

Complex histories of immigration, extinction, long-term persistence, genetic drift and local evolution determine species occurrence on islands . Only a few studies used sufficiently large and complete datasets to disentangle these biogeographic processes. We studied the faunal structure (richness and nestedness) and the genetic patterns (the COI gene) of the butterfly assemblages occurring on South-Western Sicilian islands . GLM analysis of richness revealed that some of the species acquired by the Maltese islands and Lampedusa during the Pleistocene probably survived until recent time. The nestedness pattern clearly showed the existence of (i) a group of "core species" and (ii) a group of less mobile "satellite species" sometimes showing high genetic contrasts. Such contrasts revealed to be a constant pattern separating populations from three main areas: (i) Maghreb-Lampedusa, (ii) Sicily-Maltese islands-Levanzo, and (iii) Calabria, while Pantelleria and Marettimo appear to be mostly inhabited by species with low genetic variability. This pattern highly mirrors the Pleistocene paleogeography. The Maltese islands host a series of species genetically identical to those of Sicily but which do not occur on other circum-Sicilian islands. These species apparently required a land-bridge to colonize Malta and should be considered as priority species for conservation.

6) Alessandro Chiarucci (BIGEA, Department of Biological, Geological and Environmental Sciences, Alma Mater Studiorum - University of Bologna, Italy) - "A CENTURY OF FLORISTIC CHANGES IN THE TUSCAN ARCHIPELAGO: HUMANS AND SCALE EFFECTS"

Convener bio-sketch

Alessandro Chiarucci is Full Professor at the Department of Biological, Geological and Environmental Sciences of the University of Bologna, where he teaches 'Phytogeography' and 'Conservation Biology'. The research topics of Alessandro includes plant community ecology, island biogeography and biodiversity assessment, with special emphasis on the patterns and determinants of species diversity at different spatial scales and the problems associated with sampling species richness at large spatial scales. This is done using a variety of methods, including the analysis of species distributional data, field plots, field experiments and data modelling. Alessandro has authored more than 100 scientific papers and book chapters, is member of many scientific societies and presently is Chief Editor of the 'Journal of Vegetation Science' and 'Applied Vegetation Science'.

Summary of the presentation

The Tuscan Archipelago is made by seven major islands and a number of islets and has been the subject of a huge number of botanical explorations. All the plant occurrences

recorded from the end of XIX century to the beginning of XXI century have been stored in a single data base after taxonomic standardization. Such a data base permitted the subdivision of high-quality floristic data into two periods (1880-1950 and 1950-2010) for the seven major islands and eight islets. Such data were used to perform quantitative analyses of the floristic changes in terms of species-area relationships and diversity partitioning across islands and islets. The results allowed the quantification of the changes in plant species diversity and composition due to the land-use changes and the invasion of alien species.

7) Ruben Heleno, University of Coimbra, Centre for Functional Ecology. “DO DISPERSAL SYNDROMES MATTER? INTER-ISLAND PLANT DISPERSAL IN THE CANARIES, GALAPAGOS AND AZORES”

Convener bio-sketch

Ruben Heleno is a young researcher mostly interested in seed dispersal, pollination and other ecological networks and their interfaces with island biogeography, conservation and restoration science. He has conducted and lead research in the Azores, Galapagos and in Gorongosa – Mozambique.

Summary of the presentation

Vectors of plant colonization of remote islands have been classily “guesstimated” directly from plant diaspores. Alternatively, we use a frequentist approach to explore what traits have been more favourable for LDD of plants across islands within the archipelagos of the Galapagos, Azores and Canaries. The efficiency of different dispersal syndromes varied remarkably between the three archipelagos: only sea dispersal traits (thalassocorous) conferred a tangible advantage for inter-island dispersal in the Galapagos, and only fleshy fruits (endozoochorous) were beneficial in the Azores, while in the Canaries traits for endozoochory, epizoochory and thalassochory all seem to effectively promote inter-island dispersal. Interestingly, traits related to wind dispersal (anemochory) are negatively associated with plant distribution in the three archipelagos. It is yet unclear why LDD syndromes seem more important in the Canaries than elsewhere. We confirmed previous findings that the dispersal of unspecialized diaspores is not significantly diminished and lend further support for the idiosyncrasy of LDD syndromes and to the importance of non-standard dispersal events for island colonization.

8) Sandra Nogué (PALAEOECOLOGY AND ISLANDS)

Sandra Nogué^{1,2}, Lea de Nascimento³, Cindy Froyd⁴, Janet Wilmshurst⁵, Emily Coffey⁶, Robert Whittaker⁷, José María Fernández-Palacios⁸, Kathy J. Willis⁹

1-Long-term Ecology Laboratory, Biodiversity Institute, Department of Zoology, University of Oxford, Oxford, United Kingdom.

2-Geography and Environment. University of Southampton, United Kingdom

3- Island Ecology and Biogeography Group, Instituto Universitario de Enfermedades Tropicales y Salud Pública de Canarias (IUETSPC), University of La Laguna, La Laguna, Canary Islands, Spain.

4- Department of Geography, Swansea University, Singleton Park, Swansea, United Kingdom.

5-Landcare Research, Lincoln, New Zealand.

6-Long-term Ecology Laboratory, Biodiversity Institute, Department of Zoology, University of Oxford, Oxford, United Kingdom.

7-School of Geography and the Environment, Oxford, UK

8-Island Ecology and Biogeography Group, Instituto Universitario de Enfermedades Tropicales y Salud Pública de Canarias (IUETSPC), University of La Laguna, La Laguna, Canary Islands, Spain.

9-Long-term Ecology Laboratory, Biodiversity Institute, Department of Zoology, University of Oxford, Oxford, United Kingdom.

Convener bio-sketch

Sandra Nogué is a research fellow at the Long-term Ecology Laboratory at the University of Oxford. She has a keen interest in research at the nexus of palaeoecology and biogeography. Her work takes a community level approach to help understand how resilient individual plant species and their assemblages are to past and future disturbances such as climate change, especially in island ecosystems. She uses the unique perspective that analysis of fossil records can provide, and seeks to couple this with ancient molecules.

Summary of the presentation

A number of environmental assessments highlight the importance of understanding vegetation sensitivity to changes in the environment. In this context, oceanic islands are of particular interest as some of them (mainly small islands) have been identified as vulnerable to the adverse impacts of climate change. In this study, we analyse the role

of long-term data in generating management information for island ecosystems by asking: How sensitive are the island ecosystems to past climate change? Which was the impact of the arrival of humans and/or invasive species? These questions are of importance in terms of Island biodiversity conservation. Long-term data can expand the temporal frame of conservation land-use policy and has much to offer in light of planning for the uncertainty of climate change which is likely to manifest over longer time-scales.

9) Jairo Patiño and Alain Vanderporten (Department of Biology, Ecology and Evolution, University of Liège) - "APPROXIMATE BAYESIAN COMPUTATION REVEALS THE CRUCIAL ROLE OF OCEANIC ISLANDS FOR THE ASSEMBLY OF CONTINENTAL BIODIVERSITY"

Convener bio-sketch

Jairo Patiño and Alain Vanderporten lead a research group of the Belgian Science Research Foundation (FNRS) on island biogeography at the University of Liège (Belgium). Using bryophytes as a model, the research group revisits fundamental paradigms, such as the loss of dispersal power on islands, through the implementation of macroecological, population genetics and phylogeographic approaches. The research group is particularly interested in the role that oceanic islands can play as reservoirs of biodiversity for continental areas and the implications that this may have for our understanding of diversity patterns, speciation, long-distance migrations, and local adaptation.

Summary of the presentation

In the oceanic island biogeography paradigm, volcanic islands are considered both engines of speciation and evolutionary dead-ends. We investigate whether such a paradigm holds for extremely mobile organisms, using bryophyte species that are disjunct between the mid-Atlantic Macaronesian archipelagos and Western Europe as a model. We compared the genetic structure and diversity observed in island and continental populations with those data simulated under three competing demographic scenarios, according to which: island populations derive from continental ones in agreement with classical island biogeography theory; gene flow from islands to continents and viceversa are recurrent and balanced, providing support to the hypothesis that islands have served as glacial refugia; and island populations are the source of colonists of continental landmasses *de novo*. Using an Approximate Bayesian Computation framework, we demonstrate that the patterns of genetic variation

observed in the species examined are more compatible with a scenario in which continental populations have a Macaronesian origin. Our results therefore indicate that oceanic islands may be a key source of biodiversity for continental regions.

10) – Giovanni Strona (European Commission, Joint Research Center, Institute for Environment and Sustainability) - "HOSTS AS ISLANDS?"

Convener bio-sketch

Giovanni Strona is a Grantholder at the Joint Research Center of the European Commission. His research aims mainly at understanding the ecological and co-evolutionary processes ruling host-parasite interactions. He has investigated this issue using various approaches and providing various methodological advances also relevant to other fields besides parasitology. In particular, he has contributed to the field of community matrix analysis by elaborating new null model techniques, measures and software tools.

Summary of the presentation

The idea of applying island biogeography theory, and especially species-area curves, to host-parasite systems (in which hosts are assumed as “islands” and parasites as species “inhabiting” these islands) dates back from the sixties. Although caveats have been posed soon after the first formulation of the idea the central assumption that hosts can be treated as islands has become more and more established over time. Experimental data have often provided contrasting results, thus emphasizing the need for a more thorough evaluation of how and how much the island paradigm can help understanding host-parasite relationships. A better grasp on this issue would be crucial to evaluate how parasites could respond to the disruption of long-standing biogeographical barriers due to climate- and human-driven biological invasions. In this presentation, we will discuss how the peculiar structure of host-parasite networks, the enemy release hypothesis, the possible discrepancy between host and parasite ranges, and the evolutionary tendency of parasites towards specialization can make parasites much different from islands. In addition, we will show how many of the difficulties to test these issues, and most notably the poor availability of parasitological data, can be partially solved by using artificial life simulations and digitally evolving organisms.