Seed dispersal on islands

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Island ecosystems are famous as natural laboratories for studies in ecology and evolution because of their isolated and relative simple ecosystems. However, compared to continental ecosystems, seed dispersal interactions on islands have only been little studied. And yet, among the 'noise' of all the quirky, endemic evolutionary ecology that makes island biology so fascinating, there may be general patterns. For example, while plant diversity on islands is highly idiosyncratic, insular frugivore communities are often assembled from a fairly low number of taxonomical groups, e.g. lizards, tortoises, pigeons, fruitbats. Sadly, islands are also among the most devastated ecosystems worldwide. Scientists and practicioners battle against high rates of extinction and an overwhelming tide of invasive species. In this symposium we aim to explore & highlight the current status of seed dispersal research on islands, both oceanic and continental—with a broad focus on ecology, evolution and conservation.

Photos : Top : juvenile Mauritius bulbul, *Hypsipetes olivaceus* eating fruits of *Ficus reflexa*. Middle : A blue-tailed day gecko, *Phelsuma cepediana*, eating pulp from a *Roussea simplex* fruit. Bottom : Aldabra Giant Tortoise (*Aldabrachelys gigantea*) eating a palm fruit in Mauritius. All photos © Dennis Hansen. More about tortoise.

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Plenary 30'

Seed dispersal on islands: a global overview of insular frugivores

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Island ecosystems are famous as natural laboratories for studies in ecology and evolution because of their isolated and relative simple ecosystems. However, compared to continental ecosystems, seed dispersal interactions on islands have only been little studied. And yet, among the 'noise' of all the quirky, endemic evolutionary ecology that makes island biology so fascinating, there may be general patterns. For example, while plant diversity on islands is highly idiosyncratic, insular frugivore communities are, or were, often assembled from a fairly low number of taxonomical groups, e.g. lizards, tortoises, pigeons, and fruitbats. We here present a global overview of island frugivores, focusing on broad-scale taxonomical and geographical patterns. Using a subset of the world's tropical and subtropical islands, both continental and oceanic, we investigate effects of island size, age and isolation on frugivore assemblages, and highlight global patterns. We further explore how recent extinctions have likely influenced seed dispersal interactions on islands.

Oral 15'

The time is ripe for the study of seed dispersal by bats in the greatest of the Antilles: identification of the species involved and a preliminary characterization of the interaction

Annabelle Vidal[1], Danny Rojas[2], Angel Vale[3], Vitoria Ferrero[3], Luis Navarro[4]

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The abilities of bats as seed dispersers and its contribution to forest regeneration have been highlighted. In the Caribbean islands a small group of phyllostomid bats play the role of its continental counterparts. The characteristics of this interaction in the Antillean region have been poorly described and the impact of bats to forest regeneration has received little attention. In our work we identify native and introduced plants that are dispersed by bats in the Cuban archipelago. Morphometry of fruits is described and related to skull and jaw characteristics. Distances of dispersion of fruits from the parental trees are related to locomotion indexes of bats. The composition of the diet of fruit-eating bats is also examined, and the ecological contributions of bats are assessed for the main plant formations of Cuba. Finally it is presented a list of plants that are dispersed by Cuban bats, which includes about 90 species of 35 families and its location in the Cuban archipelago. This list can become a baseline for the study of this interaction in fragile and unique insular ecosystems as inland mogotes and coastal vegetation.

Giant frugivorous lizards and *Pandanus*: seed dispersal and seed fate in lowland dipterocarp forests of the Philippine Islands

Daniel Bennett[1]

[1] Polillo Butaan Poject

Pandanus are an important component of the subcanopy of some lowland dipterocarp forests in the Philippines, and provide unique microhabitats for many fungi and vertebrate and invertebrate fauna. At least three species of large (>7kg), frugivorous monitor lizards occur in the Philippines, all of which appear to be dependant on *Pandanus* species. On Polillo Island, Quezon Province, *Varanus olivaceus* feeds on *P. radicans* (present in 39.1% of fecal samples) and *P. simplex* (present in 8.4% of samples), and appear to be the only animals that ingest these drupes. Whilst virtually all fruiting *P. simplex* trees in forests were visited by lizards, less than 50% of fruiting *P. radicans* were visited. Lizards deposited feces containing an average of 8 or 9 *Pandanus* drupes a mean of 46m (*P. radicans*) and 93m (*P. simplex*) from the nearest potential parent plant. Germination of *P. radicans* and *P. simplex* seeds was observed in 62% and 33% of feces left *in situ* and revisited after 1-3 years, with mean germination rates per fecal clump of 25.4% and 23.7%, respectively. Germination for *Pandanus* was slower than for most other seed species in fecal clumps, and many drupes which had not germinated were still viable two years or more after deposition. The results

indicate that the lizards are important dispersers of *Pandanus*. However, anecdotal evidence suggests that *P. simplex* might not be a natural component of the forest flora, but introduced by lizards from plants introduced to the island by people and planted near forest edges.

Estimating the effectiveness of seed dispersers: The seed dispersal system of *Corema album* in the Cíes Island

María Calviño-Cancela[1]

[1] Dept. Ecology and Animal Biology, University of Vigo

Effectiveness is the best parameter to express the benefit that a plant obtains from a disperser. It is crucial to understand the ecological and evolutionary consequences of seed dispersal but remains largely uninvestigated as it is very complex to measure. We measured the effectiveness of seed dispersers (gulls, *Larus michahellis*, blackbirds, *Turdus merula*, and rabbits, *Oryctolagus cuniculus*) of the shrub *Corema album* (Empetraceae) in the Cíes Islands (NW Spain) with a stochastic simulation model of the recruitment process parameterized with field data of seed dispersal, predation, and seedling emergence, and validated with independent data on seedling density. This model presents several advantages compared to previous models of plant recruitment and allows estimating, for the first time, disperser effectiveness as seedlings/m^2 contributed by each disperser. Gulls were 3-125 times more effective than the other species. Plant dependence on each disperser differed between the 3 habitats studied. Quantity and quality of dispersal were not correlated. Quality was a better predictor of effectiveness. A sensitivity analysis showed marked differences in the impact of frugivores depending on fruit avalilability: poor-quality dispersers had positive effects on recruitment with high fruit availability, but negative when fruits were limited. Thus, the same species may play a positive or negative role depending on the circumstances, which may vary at both spatial and temporal scales.

Pigeons as frugivores on insular environments: the case of two sympatric species in the Canary Islands

Manuel Nogales[1], Patricia Marrero[1]

[1] Island Ecology and Evolution Research Group, IPNA-CSIC

The frugivory is the predominant trophic strategy adopted by many insular species of pigeons, playing an important role on the structure and composition of plant communities. In a recent review carried out by our research group, we suggested that more detailed and systematic studies on diet should be performed to understand the ecological and evolutionary effects of pigeons on their ecosystems. Probably this lack of information is due to the methodological complexity of these trophic studies. Therefore, we decided to develop some complementary techniques which were applied on the two endemic pigeons of the Canary Islands (/Columba bollii/ and /C. junoniae/). Due to the fact that in the Canaries inhabits two species of endangered pigeons, it was convenient to study the diet by the development of non-invasive methods, based in droppings. Therefore, firs table, it was necessary to develop protocols of extraction and amplification of DNA in order to identify both pigeons from a genetic point of

view. Once identified the droppings, we proceeded to the microhistological study of the diet and trophic ecology of both endemic pigeons. As general patterns, we have confirmed that both species have a vegetarian diet and that they share a high number of diet components. However, the quantitative component is clearly different.

Novel dispersal relationships on remote oceanic islands affect native communities and species invasions in French Polynesia

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The arrival of introduced organisms on remote oceanic islands can disrupt mutualisms between frugivores and plants. These changes can trigger cascading consequences for native communities and can facilitate the spread of invasive plants. In the tropical high islands of French Polynesia, three frugivores disperse the seeds of many plants, both native and exotic. We investigated the network of relationships between frugivores and fruit bearing plants on the islands of Tahiti and Moorea. Bird diet was determined through analysis of fecal samples. Seed viability was assessed with germination tests with seeds extracted from intact fruits and fecal samples. Our results show a high level of integration between native and exotic organisms. Birds consumed the fruits of 21 species, 13 of which are introduced and naturalized. Exotic seeds remain viable after digestion, while the seeds of two native plants show enhanced germination after digestion by native frugivores highlighting the important role of dispersal. Native frugivores consume many exotic species which provide a highly abundant and continuously available resource. These indirect impacts of species invasions are likely to be detrimental to the regeneration of native forests.

Restoring seed dispersal functions using taxon substitutes

Christine Griffiths[1]

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Restoring ecosystem functions, such as endozoochorous seed dispersal, on oceanic islands using native fauna may be impossible. Large seeds often require suitably large dispersers. The disproportionate extinction of large vertebrates and oceanic islands' lower functional diversity means that plant species with large seeds are often anachronistic. On the offshore island, Ile aux Aigrettes (Mauritius), I investigated whether the fruits of the native ebony, *Diospyros egrettarum*, were seed dispersal limited. Historically, these fruits were dispersed primarily by the extinct Mauritian giant tortoises, *Cylindraspis triserrata* and *C. inepta*, that occurred in large densities. In 2000, a small population of Aldabran giant tortoise, *Aldabrachelys gigantea*, were introduced with the aim of reinstating the lost seed dispersal function once performed by the extinct Mauritian tortoises. Here, I provide the first empirical data indicating that these taxon substitutes are capable of restoring ecosystem functions. In addition, I found that dispersal improved fitness and survival supporting the Janzen-Connell model, and that

gut passage enhanced the germination rate and percentage of seeds that germinated. When suitable native species are unavailable, carefully selected exotic species, taxon substitutes, can be used to restore missing ecosystem functions and aid ecological restoration.