Davis Expedition Fund

Fieldwork in Colombia for the project "Explaining the differences in African and South American species richness by comparing diversification rates: The Andean orogeny hypothesis."

Extended report

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Expedition/Project Title:	Fieldwork in Colombia for the project "Explaining the differences in African and South American species richness by comparing diversification rates: The Andean orogeny hypothesis."
Travel Dates:	10th July 2012 - 17 August 2012
Location:	Colombia (Cundinarmarca, Tolima and Valle del Cauca)
Group Members:	Eugenio Valderrama
Aims:	Plant collection of Colombian species within *Renealmia* genus (Zingiberaceae) for biogeographical study

Project description

The high richness in tropical forest is not uniform with Africa being species-poor when compared to Southeast Asia and the Neotropics. Alwin Gentry proposed that the Neotropics are more species-rich because of recent speciation attributed to the opportunities for speciation that the uplift of the tropical Andes offered (*1*). In spite of the accumulating evidence supporting the importance of the Andean orogeny in the diversification of Neotropical organisms (*2-7*) few attempts have been made to test Gentry's "Andean orogeny" hypothesis (*8*). Gentry identified 'Andean centred genera' that contributed to the high species diversity in the Neotropics and cited the genus *Renealmia* (Zingiberaceae) as being a model example (*1*).

The Amphi-Atlantic distributions of some tropical plant lineages are ideal scenarios to test the Andean orogeny hypothesis, where we could expect higher diversification rates in Neotropical lineages associated with the final Andean uplift periods than in the African distributed ones. *Renealmia* is unusually well-represented on both sides of the Atlantic with c. 15 species in Africa and 61 Andean centred taxa in the Neotropics (*9-12*). Although some evidence supporting the influence of Andean orogeny in the diversification of this genus is available (*8*), increased taxon sampling and molecular markers are needed to accurately compare the speciation rates between Neotropical and African lineages.

I aim to test Gentry's hypothesis with several phylogeny based methods in *Renealmia*. I will first complete the taxon sampling in *Renealmia* and determine variable molecular markers to resolve the relationships among the species in the genus. Secondly I will test the Andean orogeny hypothesis by estimating diversification rates in the Neotropical and African lineages taking into account the stochasticity inherent to diversification processes (*13-15*). Finally I will gather available data from additional organisms distributed in the Neotropics and Africa with species-level phylogenies to test whether multiple lineages support the Andean orogeny hypothesis.

Fieldwork in Colombia objectives

To collect material (herbarium specimens, silica dried leaves, seeds, spirit samples, photos) of Colombian *Renealmia* species.

Methods

Within the Neotropical region where most of *Renealmia* diversity occurs (c. 61 species), Colombia is the country where more *Renealmia* species are found (c. 30 species) (*9*). Colombian species encompass a big range of the elevation gradient found in the Andean ridges (from sea level to 3000 m.a.s.l.). Following Dr. Paul Maas advice and available distributional data I sampled the areas of the Andean Western Ridge in Colombia and its western slope where I could maximise the number of species collected and where more fieldwork is needed. Also I sampled localities in the Andean Eastern Ridge for covering a broader area of the Colombian Andes with my sampling.

With the help of my fieldwork assistant Maria Pinilla Vargas (biologist from the Universidad de los Andes) I visited the following six localities. The former three correspond to the Eastern Ridge - Western slope and the other three to the Western slope of the Western Ridge of the Colombian Andes (Figure 1.)

1. Finca San Jose - Tena, Cundinamarca. Road Bogotá - La Mesa. Andean montane moist forest, 1830 - 2000 m.a.s.l.
2. Finca la Primorosa, Vereda La Lindosa. Nocaima - Cundinamarca. Sub-Andean moist forest, 1240 -1300 m.a.s.l.
3. Finca Madrigal, Vereda Buenavista. Melgar - Cundinamarca. Sub-Andean dry to moist forest, 663 - 726 m.a.s.l.
4. Reserva El Refugio, Carretera Cali-Dagua. Dagua - Valle del Cauca. Andean montane moist forest, 1820 m.a.s.l.
5. Road of Cañón del Río Bravo and Lago Calima. Road Dagua - Buga, Valle del Cauca. Andean montane moist forest, 1228 -1682 m.a.s.l.
6. Reserva Cerro El Inglés, Corporación Serraniagua. Border between Valle del Cauca and Chocó departments, El Cairo - Valle del Cauca. Andean montane moist forest, 2100 -2198 m.a.s.l.

Travels among fieldwork localities were made in a rented 4x4 vehicle, which allowed access to remote places and disposition of required materials. Local guides were hired in every place and asked for advice on the best places to look for *Renealmia* with pictures of the plants and descriptions of its habitat. Samples of fertile plants were collected in the field for herbarium specimens. Full description of the plant, surrounding habitat, locality (including accurate latitude and longitude values for each point) and photos were made for each collected plant. Samples of young and healthy leaves for each specimen were stored in tea bags and dried with silica gel for high quality DNA extractions. Spirit collections of flowers or fruits were made for each plant when they were available. When possible the collections were kept alive until preparation in the herbarium, as this was not feasible in several localities, the plants were pressed in the field and stored in sealed plastic bags after being soaked in alcohol for fungi or decomposition avoidance.

The herbarium specimens and associated material were properly deposited in the Museo de Historia Natural ANDES of the Universidad de los Andes in Bogotá. Duplicates for RBGE herbarium and for Dr. Paul Maas of the Nationaal Herbarium Nederland (Wageningen University branch and expert on the genus taxonomy) will be sent as soon as exportation permits are processed.

Schedule:

14th July: Drive from Bogotá to Finca San Jose, plants collection and return to Bogotá.
15th to 16th July: Drive to Finca La Primorosa, plants collection and return to Bogotá.
17th to 18th July: Processing and deposition of herbarium specimens in the ANDES museum of natural history Universidad de los Andes (Bogotá).
19th to 22nd July: Drive to Finca Madrigal, plants collection and return to Bogotá.
23nd to 26th July: Processing and deposition of herbarium specimens in the ANDES museum of natural history Universidad de los Andes (Bogotá) and materials acquisition.
27th July: Drive from Bogotá to Cali.
28th July: Drive from Cali to Reserva El Refugio, plants collection and preparation of herbarium specimens.
29th July: Plants collection in Reserva El Refugio and surrounding areas and preparation of herbarium specimens.
30th July: Drive to Cañón del Río Bravo and Lago Calima, plants collection and return to Cali.
31st July to 1st August: Preparation of herbarium specimens and materials acquisition.
2nd August: Drive from Cali to Reserva Cerro El Inglés.
3rd to 5th August: Plants collection in Reserva Cerro El Inglés, preparation of herbarium specimens and return to Cali.
6th August: Preparation of herbarium specimens.
7th August: Drive from Cali to Bogotá.
8th-15th August: Preparation of herbarium specimens and deposition of herbarium specimens in the ANDES museum of natural history Universidad de los Andes (Bogotá).

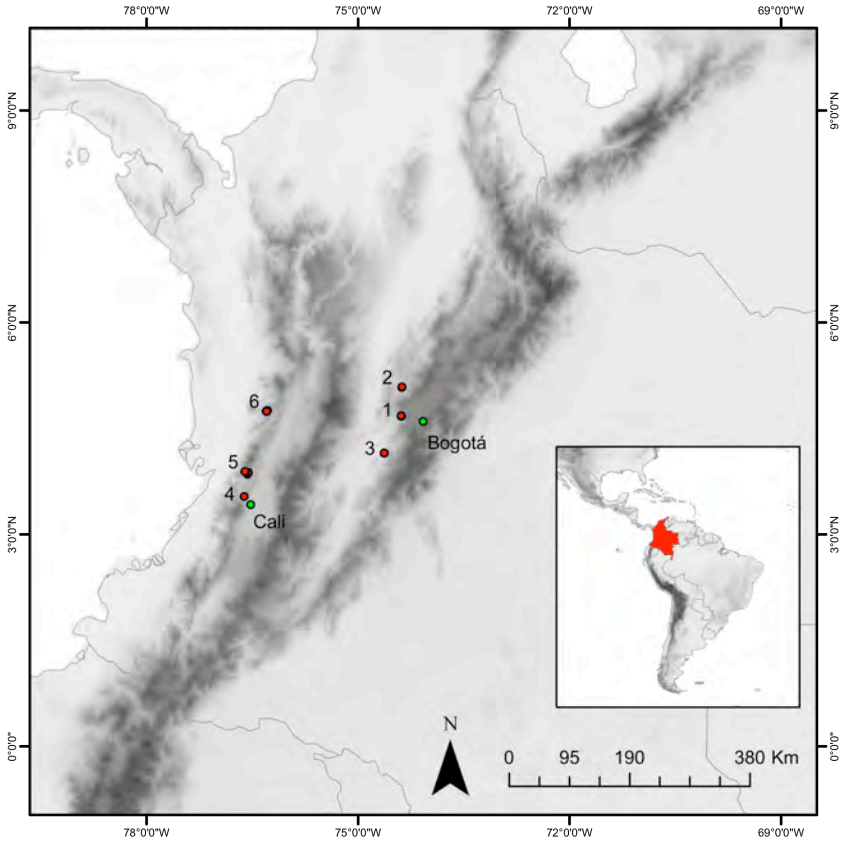

Figure 1. Geographical location of the sampling localities (red points) as listed in the Methods section and main cities (labelled green points) used as stations between fieldwork periods.

Results

We collected 10 *Renealmia* species in the visited localities (Table 1.). In the estern slope of the Eastern Ridge of the Colombian Andes (corresponding to localities 1,2 and 3, Figure 1.) we found three species. In the western slope of the Western Ridge we found the remaining seven species and a remarkable higher diversity of *Renealmia* species in the region, especially in the locality number six where we found six species (of which just 1 was shared with the other sampling points).

Table 1. Sampling locality as in Figure 1, number of individuals, elevation and availability of fruits/flowers for each species.

Taxon	Locality	Individuals	Flowers/Fruits	Elevation (m.a.s.l.)
R. alpinia	1, 5	4	Flowers/Fruits	1487 - 1985
R. cernua	2, 3	5	Flowers/Fruits	664 - 1296
R. ligulata	4, 5	2	Flowers/Fruits	1301 - 1820
R. fragilis	5, 6	3	Flowers/Fruits	1497 - 2070
R. lucida	5	1	Flowers/Fruits	1492
R. nicolaioides	6	1	Flowers/Fruits	2197
R. cf. ferruginea	6	1	Flowers/Fruits	2138
R. sp.1	6	3	Flowers/Fruits	2100 - 2137
R. sp.2	6	2	Flowers/Fruits	2134 - 2137
R. sp.3	6	2	Flowers/Fruits	2101 - 2151

Taking into account that in Colombia occur c. 30 described species we consider that the expedition was fruitful in terms of number of species. Some of the species we found don't seem to fit in the available descriptions (*9-12*) (*Renealmia sp*. 1, 2 and 3 in Table 1). Further work with the specimens in the RBGE herbarium and the material revision by the expert on the genus taxonomy is still necessary but the possibility of undescribed species within our collections is exciting.

Final Budget

Description	Colombian Pesos	£*
Accommodation	450,000	155.81
Bank transfers	NA	31.92
Car rental	1,800,000	623.22
Field assistant	870,000	301.22
Food	816,311	282.63
Guidance	500,000	173.12
Materials	150,440	52.09
Mobile phone credit	60,000	20.77
Petrol	748,050	259.00
Reserve entrance fees	60,000	20.77
Return flight tickets	NA	821.94
Road tolls	358,900	124.26
	Total:	£2,866.76

David Expedition Trust: £2,875
Remaining funds: £8.24
* Currency exchange rate £1 = 2888.22 COP

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