‘Islands in the Sky’
‘Islands in the Sky’ - Tepuis

- Guayana Shield centered in southern Venezuela
- $1.2 \times 10^6 \text{ m}^2$
- Sandstone table mountains of Roraima Formation

Autana, 1300 m
‘Islands in the Sky’ - Tepuis

- Roraima Formation - Precambrian, highly leached sandy marine sediments laid down 1.5 - 1.8 billions years ago

- Roraima Formation uplifted during formation of Atlantic in Cretaceous

- tepuis formed with erosion of major river systems (Orinoco) – vicariance?

- tepuis are resistant (quartzite) mesas
Autana, 1300 m
Roraima, 2723 m
Kukenán, 2650 m
Neblina, 3014 m
‘Islands in the Sky’ - Tepuis

- tepuis basis for Sir Arthur Conan Doyle’s “The Lost World”

- actually home to one of the world’s largest set of plant “carnivores”
‘Islands in the Sky’ - Tepuis

- tepuis basis for opening scene of *Arachnophobia*

*Canaima National Park*
‘Islands in the Sky’ - Tepuis

- Pantepui - biogeographic province proposed by the Phelps for high elevation “island” portion over 1500 m
‘Islands in the Sky’ - Tepuis

- Pantepui - biogeographic province proposed by the Phelps for high elevation “island” portion over 1500 m

- characterized by a combination of extreme conditions: cool weather, heavy rainfalls, dense clouds, strong winds, high solar radiation, and extremely infertile substrates
‘Islands in the Sky’ - Tepuis

- Pantepui - biogeographic province proposed by the Phelps for high elevation portion over 1500 m

- Distinctive biota

Tepui vireo

Redbanded fruiteater

Tepui manakin

Rana

Asteraceae
Do the tepuis function as islands?

Ricarda Riina
Tepui Flora

• Pantepui - island like species/area relationship

Riki Olivares - M.S. thesis
**Tepui Flora**

- **Pantepui - island like endemism**

## Overall plant richness and endemism

<table>
<thead>
<tr>
<th></th>
<th>Pantepui taxa</th>
<th>Shield endemics</th>
<th>Pantepui endemics</th>
<th>Single tepui endemics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Families</td>
<td>156</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Genera</td>
<td>626</td>
<td>80</td>
<td>23 (4%)</td>
<td>13 (2%)</td>
</tr>
<tr>
<td>Species</td>
<td>2447</td>
<td>1517</td>
<td>1034 (42%)</td>
<td>617 (25%)</td>
</tr>
</tbody>
</table>

Riki Olivares - M.S. thesis
Tepui Flora

- Floristic relationships among tepuis
- Is there a biogeographical pattern?
  - vicariance formed by river erosion?

Vicki Funk - Smithsonian
Guayana Shield - pantepui area

eastern tepuis

western tepuis
Guayana Shield - pantepui area

eastern tepuis

western tepuis
Tepui Flora

• positive significant ($P = 0.001$) correlation between the floristic distance matrix and the among-tepuis geographic distance matrix (Mantel Test)
‘Islands in the Sky’ - Paramo, Afroalpine
‘Islands in the Sky’ - Paramo, Afroalpine

- convergent biome types across high elevation areas of the tropics
- depending on elevation, often occur as ‘islands’
‘Islands in the Sky’ - Paramo, Afroalpine

- South American **paramo** and East African **afroalpine** (‘Ethiopian’) best studied floristically as islands
‘Islands in the Sky’ - Paramo, Afroalpine

- ecology is harsh and unvarying: ‘winter by night, summer by day’

Figure 2. Thermograms from Teleki Valley, Mt. Kenya (4200 m). Upper thermogram recorded on the valley slope, 50 cm above the ground between a few big boulders. Lower one obtained on flat valley bottom, 10 cm above the surface, in shadow of *Dendrosericea keniensis* leaves. Horizontal distance is 50 m; difference in altitude is less than 5 m (modified from Hedberg, 1964b).
‘Islands in the Sky’ - Paramo, Afroalpine

- Convergent life forms occur in both areas as a response to these ecological conditions.

*Figure 3. The five most important life forms of the afroalpine belt. A. giant rosette plant, B. tussock grass, C. acaulescent rosette plant, D. cushion plant, E. sclerophyllous shrub (modified from Hedberg, 1964a).*

*Hypericum* (sclerophyll)

*Erica* (sclerophyll)

*Viola* (cushion)

*Acaena* (rosette)

tussock grass
‘Islands in the Sky’ - Paramo, Afroalpine

- Convergent life forms occur in both areas as a response to these ecological conditions

**Dendrosenecio (Asteraceae)**

**Lobelia (Lobeliaceae)**
‘Islands in the Sky’ – Paramo, Afroalpine

- Convergent life forms occur in both areas as a response to these ecological conditions.

**Puya** (Bromeliaceae)

**Espeletia** (Asteraceae)
Radiation in Andean *Puya* (Bromeliaceae)

Rachel Schmidt Jabaily

*Puya raimondii*, Ancash, Peru
Radiation in Andean *Puya* (Bromeliaceae)

Direction of latitudinal and elevation shifts?
Radiation in Andean Puya (Bromeliaceae)

“mapping” on latitude & elevation on DNA tree

Jabaily & Sytsma 2013
Radiation in Andean *Puya* (Bromeliaceae)

Relative rates of movements in latitude and elevation

*Jabaily & Sytsma 2013*
‘Islands in the Sky’ - Paramo, Afroalpine

- Biogeography of afroalpine flora – adaptive radiation of *Dendrosenecio* (Asteraceae)
‘Islands in the Sky’ - Paramo, Afroalpine

- Biogeography of afroalpine flora – adaptive radiation of *Dendrosenecio* (Asteraceae) Which pattern?

1. Inter-island dispersal followed by elevation shifts
2. Multiple dispersals from similar elevations

Mt. Kenya

Eric Knox

8 species adapted to 4 life zones (in color)
‘Islands in the Sky’ - Paramo, Afroalpine

- Biogeography of afroalpine flora – adaptive radiation of *Dendrosenecio* (Asteraceae) Which pattern?
  1. Inter-island dispersal followed by elevation shifts
  2. Multiple dispersals from similar elevations

- Convergence of species adapted to similar elevations!

Phylogeny superimposed on biogeography