Biogeography of Islands

Special things go on in islands

• “island life” or “insular biology”

Island biogeography

Adaptive radiations

Dispersal
Biogeography of Islands

‘Insular Syndrome’
24 principles

1. difficulties of LDD to islands
2. isolation after establishment
3. ecological opportunities
4. moderation of maritime climate

Adaptive radiations
Adaptive Radiations

Adaptive radiations - prevalent theme on islands

- one of several processes that promote increased diversity in one lineage relative to a sister group

One lineage (clade 2) is more diverse due to combination of species radiation and adaptation into many ecological zones - perhaps due to the origin of a novel feature (key innovation) or open niches on islands.
Adaptive Radiations

Adaptive radiations - prevalent theme on islands

- *species diversification/radiation* from a common ancestral colonist has already been mentioned

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### Table 1  Geographical relationships of the indigenous vascular plants of the Galapagos Islands

<table>
<thead>
<tr>
<th></th>
<th>Endemic</th>
<th>Neotropical</th>
<th>Pantropical</th>
<th>Andean</th>
<th>Mexico and Central America</th>
<th>South America</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pteridophytes</td>
<td>8</td>
<td>52</td>
<td>14</td>
<td>15</td>
<td>2</td>
<td>91</td>
<td>83</td>
</tr>
<tr>
<td>Monocotyledons</td>
<td>20</td>
<td>38</td>
<td>22</td>
<td>3</td>
<td>2</td>
<td>83</td>
<td>348</td>
</tr>
<tr>
<td>Dicotyledons</td>
<td>208</td>
<td>65</td>
<td>26</td>
<td>43</td>
<td>4</td>
<td>2</td>
<td>348</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>236 (45%)</td>
<td>155 (30%)</td>
<td>62 (12%)</td>
<td>61 (12%)</td>
<td>4 (1%)</td>
<td>4 (1%)</td>
<td><strong>522</strong></td>
</tr>
</tbody>
</table>

### Table 2  Original introductions that have resulted in the present vascular plant flora of the Galapagos Islands

<table>
<thead>
<tr>
<th>Introduced</th>
<th>Birds</th>
<th>Man</th>
<th>Wind</th>
<th>Oceanic drift</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pteridophytes</td>
<td>1</td>
<td></td>
<td>86</td>
<td></td>
<td>87</td>
</tr>
<tr>
<td>Monocotyledons</td>
<td>58</td>
<td>38</td>
<td>14</td>
<td>2</td>
<td>112</td>
</tr>
<tr>
<td>Dicotyledons</td>
<td>166</td>
<td>143</td>
<td>18</td>
<td>33</td>
<td>360</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>225 (40%)</td>
<td>181 (32%)</td>
<td>118 (21%)</td>
<td>35 (6%)</td>
<td><strong>559</strong></td>
</tr>
<tr>
<td><strong>Total for natural introductions</strong></td>
<td>225 (60%)</td>
<td>118 (31%)</td>
<td>35 (9%)</td>
<td></td>
<td><strong>378</strong></td>
</tr>
</tbody>
</table>
Adaptive Radiations

Darwin (1853)
“...species occasionally arriving after long intervals in a new and isolated district, and having to compete with new associates, will be eminently liable to modification, and will often produce groups of modified descendants.”

Darwin’s finches
Adaptation radiations

Osborn (1900)

“. . . an isolated region, if large and sufficiently varied in its
topography, soil, climate and vegetation, will give rise to a diversified
fauna according to the law of adaptive radiation from primitive and
central types. Branches will spring off in all directions to take
advantage of every possible opportunity of securing food.”

Adaptive radiation - the rise of a diversity of
ecological roles and attendant adaptations in
different species within a lineage
(Givnish 2015)
Adaptive Radiations

The study of adaptive radiations - one problem!

... as this field involves issues of both phylogenetics and ecological modification ...
Adaptive Radiations

The study of adaptive radiations - one problem!

...telling the adaptive story of beak size, structure, function is often done using relationships based on these morphological features

Circular reasoning?
Adaptive Radiations

The study of adaptive radiations - one problem!

- molecular phylogenetics critical
Darwin’s finches - what we thought based on morphology

Darwin’s finches - what we now know based on molecular phylogenetics
Darwin’s finches - what we now know based on molecular phylogenetics
• hybridization & introgression
• species can be messy!

Darwin’s finches - what we now know based on molecular phylogenetics
Adaptive Radiations

We will examine adaptive radiations, in the context of the Hawaiian Islands