

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

Clade 1 — 10 species

Lineage Variation between Sister Clades

● Key innovation & adaptive radiation

Clade 2 — 20 species

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

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

	Endemic	Neotropical	Pantropical	Andean	Mexico and Central America	South America	Total
Peridophytes	8	52	14	15		2	91
Monocotyledons	20	38	22	3			83
Dicotyledons	208	65	26	43	4 (1%)	2	348
Total	236 (45%)	155 (30%)	62 (12%)	61 (12%)		4 (1%)	517

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

Introduced	Birds	Man	Wind	Oceanic drift	Total
Peridophytes	1		86		87
Monocotyledons	58	38	14	2	112
Dicotyledons	166	143	18	33	360
Total	225 (40%)	181 (32%)	118 (21%)	35 (6%)	559
Total for natural introductions	225 (60%)		118 (31%)	35 (9%)	378

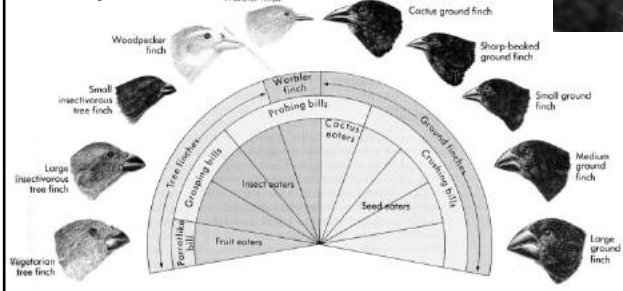
Adaptive Radiations

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



Adaptive 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)

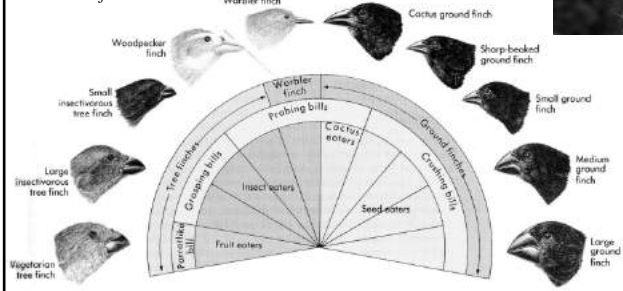
Adaptive Radiations

The study of adaptive radiations - one problem!

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



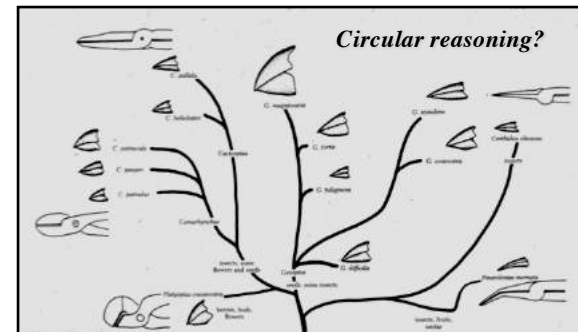
Darwin's finches



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



Adaptive Radiations

The study of adaptive radiations - one problem!

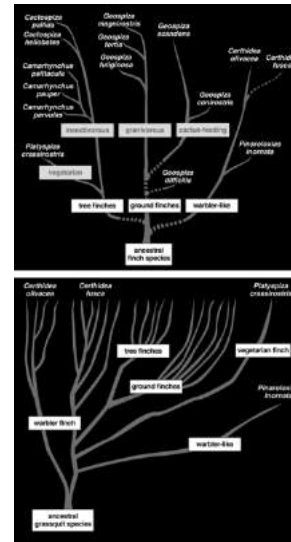


- molecular phylogenetics critical

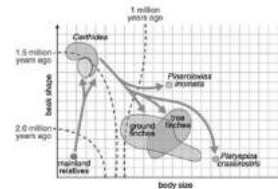
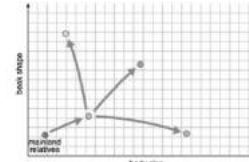
How morphology can be misleading - especially in "Island" settings -

Divergence: changes in homologous structures among related species; changes permit each species to specialize in different environments

Convergence: changes in analogous structures among unrelated species; changes permit each species to specialize in the same environment

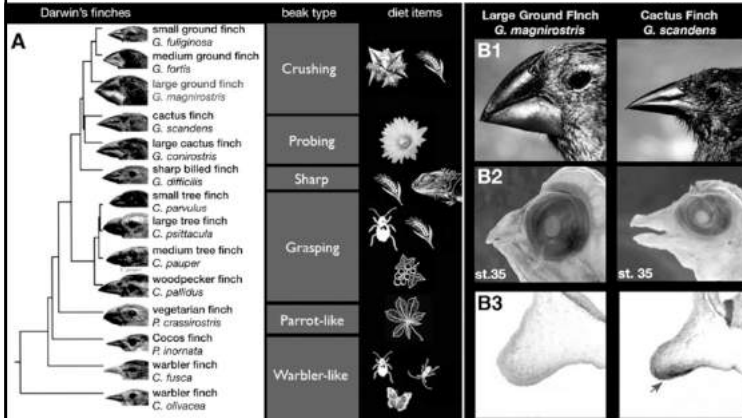


Darwin's finches - what we thought based on morphology



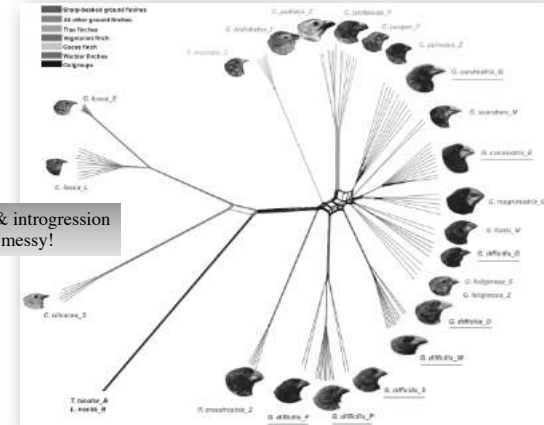
Darwin's finches - what we now know based on molecular phylogenetics

Rands et al. BMC Genomics 2013 14:95



Darwin's finches - what we now know based on molecular phylogenetics

Lamichhaney et al. Nature 2015



- hybridization & introgression
- species can be messy!

Darwin's finches - what we now know based on molecular phylogenetics

Adaptive Radiations

