"PRINCIPLES OF PHYLOGENETICS: ECOLOGY AND EVOLUTION"
Integrative Biology 200B Spring 2009
University of California, Berkeley Ackerly/Lindberg/Mishler

April 28, 2009**. Coevolution**

-- **"Coevolution" defined.** What is it exactly? It can be over-broadly defined to include *any* interaction between different lineages; that makes it basically synonymous with plain ol' "evolution." So most people take it to mean a *long-term* interaction between lineages -- but how long-term? Janzen (1980) defined it in terms of trait evolution: "evolutionary change in a trait of the individuals of one population in response to a trait of the individuals of a second population, followed by an evolutionary response by the second population to the change in the first."

-- Coevolution can occur in the context of many different ecological interactions. The interactions can be mutually beneficial, or beneficial to one lineage and either neutral or detrimental to the other:

	Effect of Interaction	
Name of Interaction	Species A	Species B
Competition	-	-
Predation/Herbivory/Parasitism	+	-
Mutualism	+	+
Commensalism/Facilitation	**0**	+

The term symbiosis refers to a *close and prolonged ecological relationship* between the individuals of two (or more) different species, and can involve mutualism, parasitism or other interactions.

If coevolution is defined to be a relationship that is long enough to continue through one or more divergences of the lineages involved, then it can be studied directly using phylogenetic comparative methods. Prolonged coevolution can lead to *cospeciation*, which will appear as phylogenetic congruence between two or more systems of lineages.

Cospeciation represents another generalization of the phylogeny/ homology relationship (which could be considered the "coevolution" of organism lineages and their characters), like other examples we have discussed such as vicariance biogeography (which is organism/ earth coevolution) or gene family evolution (which is gene/ genome coevolution).

-- Methodology:

-- These kinds of questions always involve comparing different cladograms, yet how to do this can be hypothesis-dependent. In addition to comparing topologies per se, some questions would require comparing branch lengths on the topologies, or at least comparing the presence or absence of specific characters. See specific examples on the following sheets (and corresponding overheads).

-- Like other areas of comparative methods we have discussed, the general approach is to first define the patterns you are looking for, carefully define the causal hypothesis to be tested, then specify a null hypothesis (what you would expect if the hypothesized cause is NOT working), and finally design a test that would let you reject the null hypothesis if it is indeed false. These sorts of comparative cladogram studies are in their infancy, and you could make contributions to both methods and empirical results.

Citations:

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