Application of Tree Thinking

Ancient Wings

http://www.arachnology.org/monteiro/flash/

Goals

- I. Explore how putative wing patterns of a genus of butterflies have changed over evolutionary history
- II. Use as a hypothesis-generation tool for research in evolutionary, ecological, & developmental biology

Procedure

 Identify two species in the phylogeny that have a very different history of eyespot size evolution. e.g. examine relative sizes of eyespots 3 and 4 in *B. anynana*, *B. campus* and *B. angulosus* and their most recent common ancestor (MRCA). Compare this to changes in the lineage leading to *B. sciathis.*

Likewise compare changes in the lineages leading to (ii) *B. smithi* and *B. golo*, and (iii) *B. smithi* and *B. madetes*.

What sort of evolutionary hypotheses might such comparisons be used to explore?**

- 2. Observe how the eyespots change in size and position relative to each other and relative to the wing margin. What sort of questions of functional integration may be investigated?
- 3. Changes in wing types unfold alongside a timeline in the program. How might this be used in biogeographic studies?
- 4. Mutations of large phenotypic effect are known to occur sporadically in lab populations of *Bicyclus anynana*, either introducing or removing fully developed eyespots, or shifting eyespots along the margin in an abrupt fashion (McMillan et al., 2002; Beldade and Brakefield, 2002; Monteiro et al., 2003). See if you can identify in which lineages a gradual versus a punctuational type change has occurred on an evolutionary time-scale.

**Notes:

Selective forces driving the evolution of ventral wing patterns in the genus *Bicyclus* are largely unknown.

Relatively small differences in ventral eyespots among two recently diverged species of Lycaenid butterflies played an important role in mate recognition (Fordyce et al., 2002).

In *Bicyclus*, it has been shown that dorsal eyespot size may play a role in sexual selection (Breuker and Brakefield, 2002),

Recent experimental work on *Bicyclus anynana* showed that the developmental system poses few constraints to obtaining a rapid response to artificial selection on eyespot size (Beldade et al., 2002b). In particular, selecting for opposing eyespot sizes on the same wing surface was accomplished with relative ease.

Reference:

Arbesman S, Enthoven L, & A Monteiro (2003) Ancient Wings: animating the evolution of butterfly wing patterns. BioSystems 71: 289–295