Lecture 23: MacroEvolution

First some quotes.

Nothing in Biology makes sense except in the light of Evolution (Dobzhansky)

Nothing in Evolution makes sense except in the light of Population Genetics (Lynch, IGERT talk 2006)

Nothing is Evolution makes sense except in the light of _____ (fill in the blank).

The following is from Coyne and Orr (1998) (see web page).

Some have argued that Speciation is a by-product of conventional evolutionary forces, like selection and drift…

Thus,

The origin of species is simply an epiphenomenon of normal population genetic processes.

But

Under the biological species concept (BSC), the origin of species requires joint consideration of two species, and usually an interaction between their genomes.

The distinctive feature of the genetics of speciation is therefore epistasis

1. Necessarily true for post-zygotic isolation
2. Usually true for pre-zygotic isolation

True?

And Is speciation a by-product?

(And why does epistasis only figure into conventional population genetics when it comes to speciation? See M. Wade's paper on a gene's eye view of epistasis and speciation)

In the fossil record: can the patterns of rapid morphological change (evolution), followed by long periods of stasis be explained by conventional evolutionary forces?

Neo-Darwinian view

New view from Gould & Eldridge

(plot morphology against time for both views)
(Remember Thomas Huxley?)

Quotes:

1. Is a new and more general theory of evolution emerging?

2. Marco-evolution is effectively decoupled from micro-evolution

3. NeoDarwinism is dead.

Theory of macro-migration (from R. Dawkins)

Macro-evolution (species or clade selection)

Remember the equation for density-independent population growth?

$$\frac{dN}{dt} = (births - deaths)N = rN$$

$$\frac{dN}{dt} = (b - d)N = rN$$

What if b = number of new species "born"

And d = number of species "extinctions"

Could different clades have different values for r?

Factors affecting

Speciation (birth) rate	Extinction rate
1.	1.
2.	2.
3.	3.
4.	4.

From Jablonski on larval ecology and macroevolution

Consider the following cases for marine invertebrates

1. Planktotrophic larvae (i.e., they eat plankton)

   many small larvae produced (r selected)

   widely dispersed (low isolation)

2. Non-planktotrophic larvae (they eat yolk)

   few, large offspring produced (K selected)

   dispersal is more local, leading to isolated pops.

Expectations

1. Clades with Planktotrophic larvae

   Large geographic range

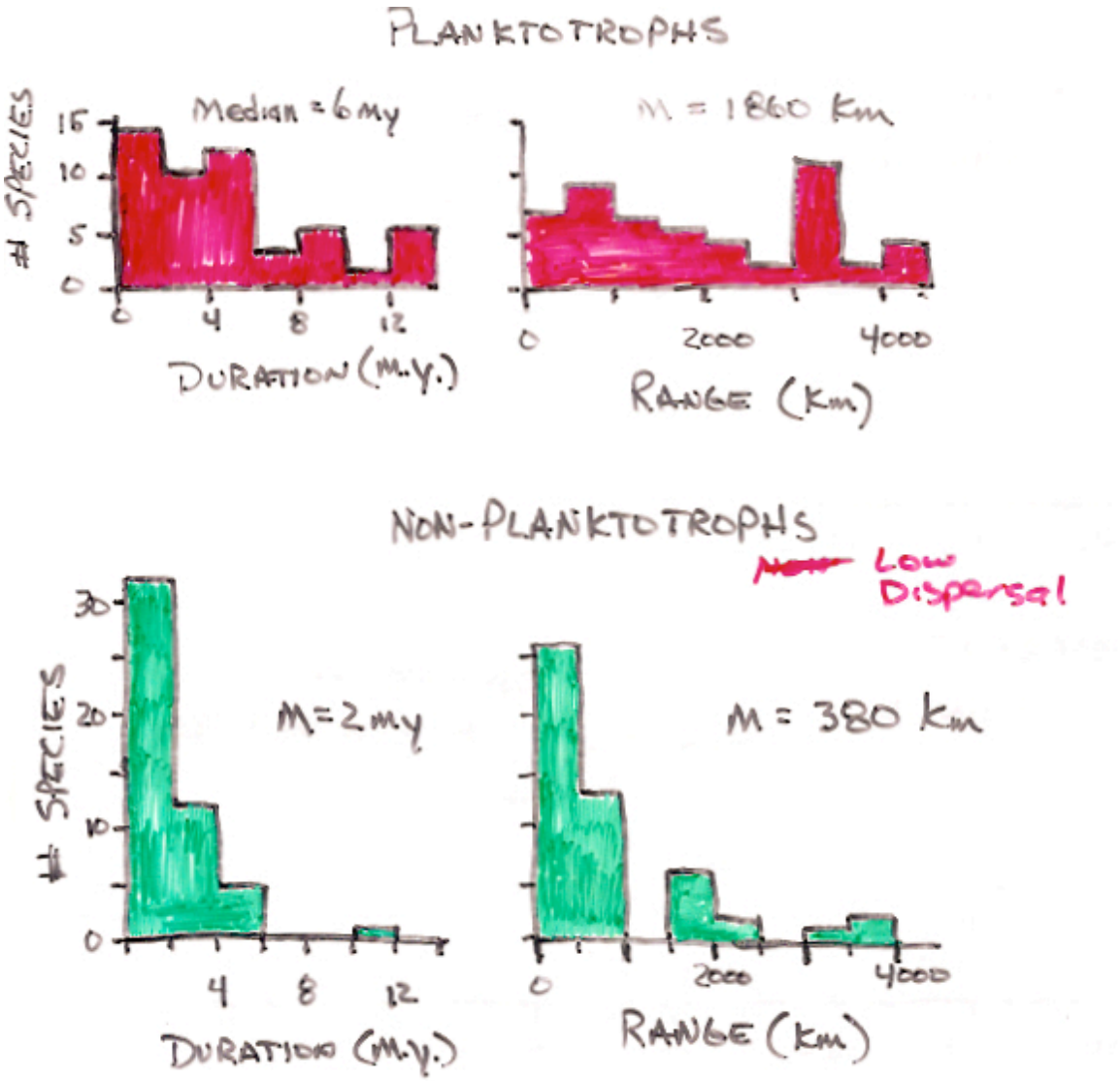
   Low speciation and extinction rates

2. Clades with Non-planktotrophic larvae

   Smaller geographic range

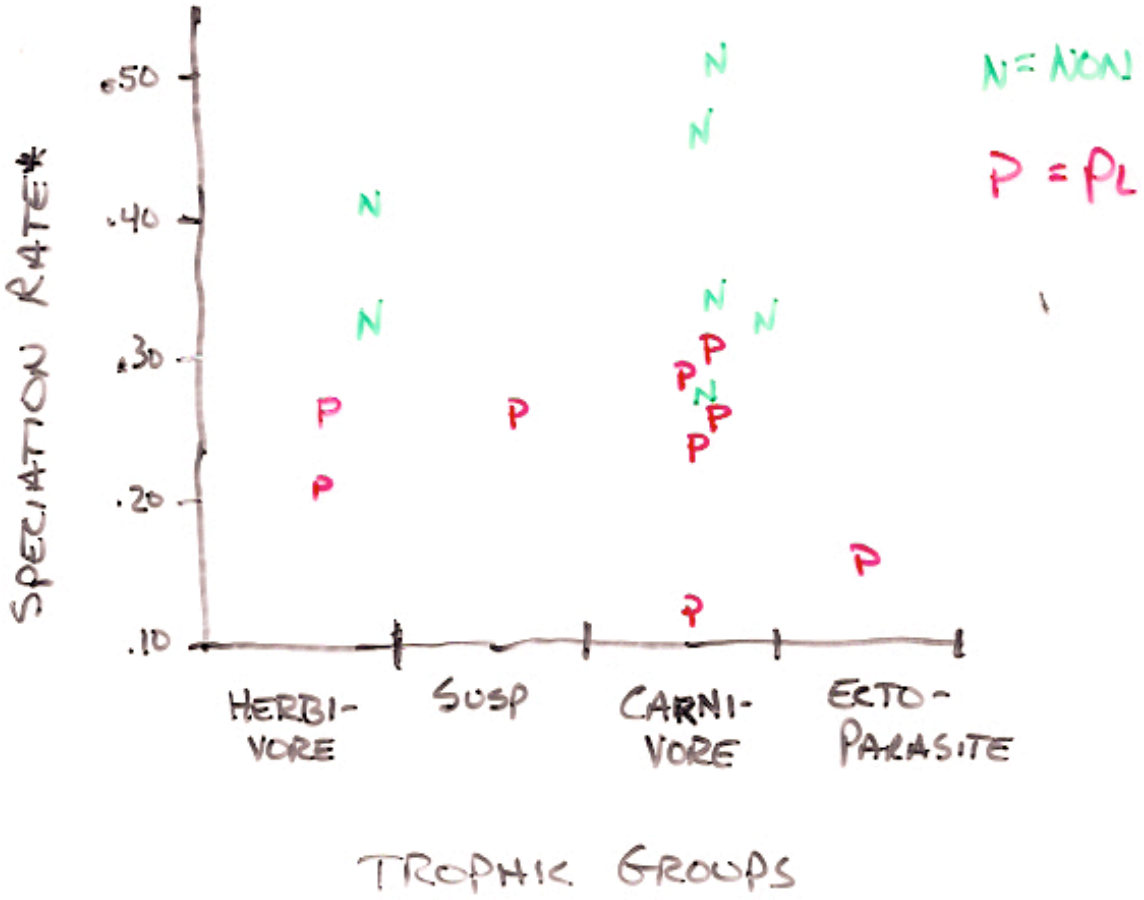
   Higher speciation and extinction rates.

   Shifting Balance?



Note that the non-planktotrophs have (as expected):
1. Higher extinction rates and
2. Smaller geographic ranges.

From: Extinction of geographic ranges of late cretaceous gastropods (Jablonski, D. 1986. Bull. Mar. Sci. 39: 565-587)



N = Non-planktotrophs
P= Planktotrophs

Note that non-planktotrophs have higher rates of speciation, independent of trophic group.

*per species per million years.

"The causal mechanisms for the observed patterns… probably lie at the hierarchical levels above the traditional neodarwinian one of the individual organism. I am most emphatically not invoking traditional group selection, but species selection in the strict sense. Differences in genetic population structure and geographic range – species level traits that are not reducible to the organismic level – are responsible for the observed patters."

From: Extinction of geographic ranges of late cretaceous gastropods (Jablonski, D. 1986. Bull. Mar. Sci. 39: 565-587)

What does this all mean?

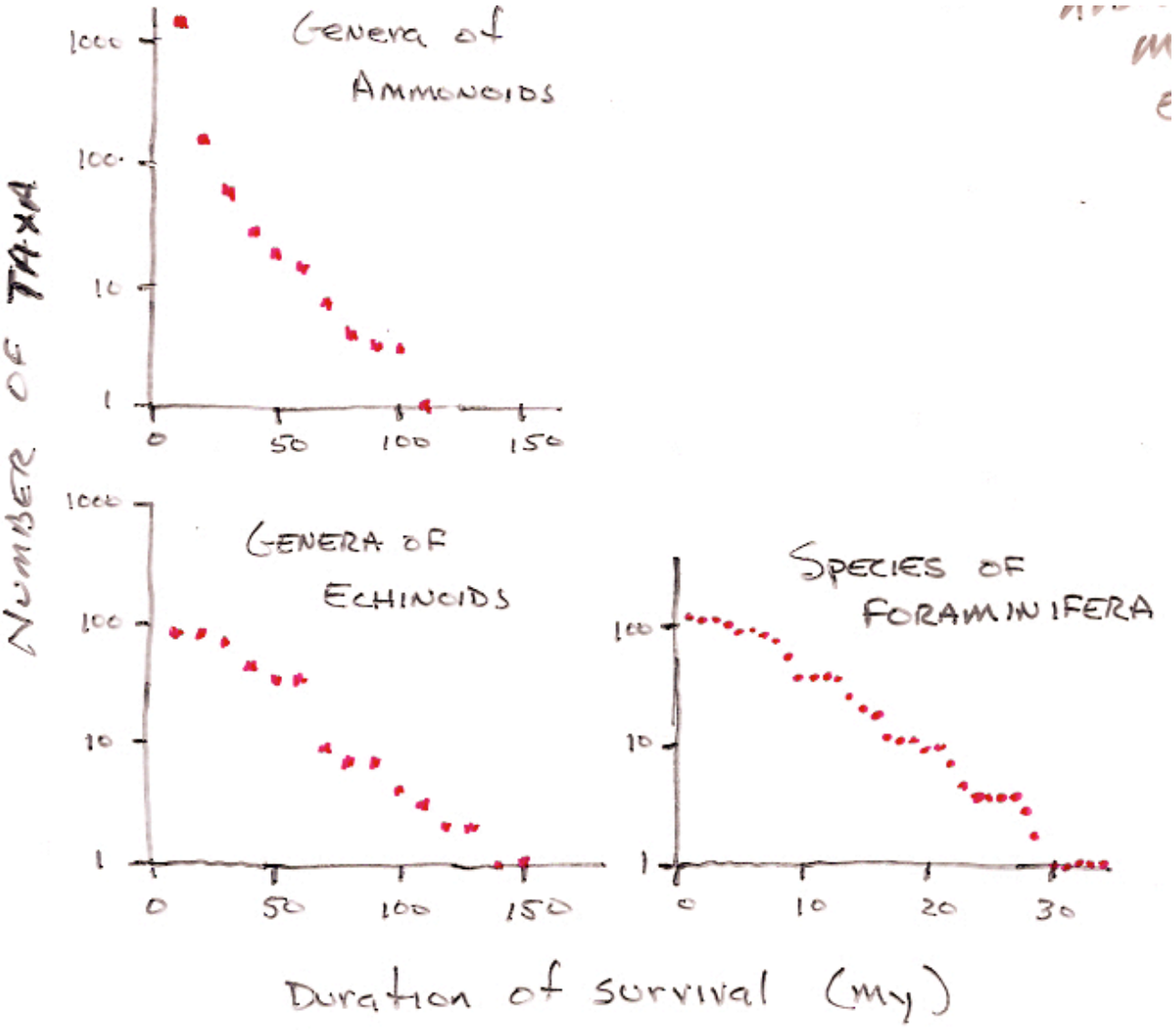
Are lineages selected to speciate? _____

What it macroevolution? _____

Is it decoupled from microevolution? _____

What is the "currency" of micro<u></u>evolution? _____

What is the "currency" of macro<u></u>evolution? _____



Speaking of extinction… How do we explain the strikingly constant rate of extinction in the above graphs? (Data from van Valen 1973)

Write answer here: