Molecules consolidate the placental mammal tree.

- The morphological consensus mammal tree
- Two decades of molecular phylogeny
- Rooting the placental mammal tree
- Parallel adaptative radiations among placental mammals
- Dating the placental mammal diversification
INTRODUCTION

• Give a framework to interpret the evolution of morphological, physiological, behavioral and genomic features.

• Evaluating the role of plate tectonics and dispersal in the biogeographic history of this group.
THE MORPHOLOGICAL TREE

Gregory, 1910

Simpson, 1945

McKenna, 1975

Novacek, 1992

Shoshani and McKenna, 1998
MOLECULAR PHYLOGENY
- USING PROTEINS -

Using hemoglobin, myoglobin, αA-cristallin, cytochrome c and ribonuclease for a limited taxon sampling:

(Czelusniak et al. 1990)

Belong to the afrotheria
MOLECULAR PHYLOGENY
- USING mtDNA -

Complete mitochondrial genomes

Confirmed hypothesis

Bats closer to ungulates than to primates

Cetaceae are nested into the artiodactyla

Cetartiodactyla

(Irwin & Arnason 1994 J.Mammal.Evol.)
(Pumo et al. 1998 JME)
MOLECULAR PHYLOGENY
- USING mtDNA -

Complete mitochondrial genomes (~ 17 000 bp)

Rejected hypothesis

Hedgehog at the base of the tree.
The guinea pig is not a rodent!!

(D’Erchia et al. 1996 Nature)
Arnason et al. 2002 PNAS)
MOLECULAR PHYLOGENY
- USING nuDNA-

When nuclear gene segments are analyzed:

- Poorly resolved and unstable topology
- Single genes can give misleading topology

However they can still support:

Hippo-whale clade

Afrotheria
MOLECULAR PHYLOGENY
-USING nuDNA-

(14 750 bp, 42 species)

In the 1980’s and 1990’s:

- Incomplete and unbalanced taxon sampling,
- Relatively short segment of single genes.

In the beginning of the 21st century:

- Concatenated DNA sequences from many different nuclear genes,
- Representatives of all extant placental orders.

(Murphy et al. 2001 Science)
MORPHOLOGICAL VS. MOLECULAR TREES

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mtDNA / nDNA RESULT DISCREPENCIES?

- Unusual nucleotide composition: violate the model of evolution
- Unbalanced taxon sampling: long branch attraction
- Hedgehog and murid rodents: changes in their mutational process
- Mitochondrial genome: lack of resolution power

↓

Importance of the methods & Importance of the taxon sampling
## THE MOLECULAR PHYLOGENY
### USING ‘RGC’ - INDELS

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<thead>
<tr>
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<td>(Poux et al. 2002 MBE)</td>
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<td>BRCA1</td>
<td>(Madsen et al. 2001 Nature)</td>
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THE MOLECULAR PHYLOGENY
- USING ‘RGC’-

Nishiara et al. 2006 PNAS
ROOTING THE PLACENTAL TREE

2. Atlantogenata

Understanding early placental biogeography
PARALLEL ADAPTATIVE RADIATIONS

Homologous vs. Analogous characters

Share a common ancestor

Same function evolve separately in different groups

Afrotheria  Laurasiatheria

Madsen et al. 2001 Nature; Springer et al. 2004 TREE

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PLACENTAL PHYLOGENY
– CONCLUSIONS –

• Morphology and Molecules agree on 16 out of the 18 placental orders.

• Molecules corroborate the morphology-based Glires and Paenungulata

• Phylogenetic problems can be resolved by
  larger taxon sampling;
  large, diverse and independant dataset;
  moderne method of analysis;
  the discovery of GRC.

• mt protein-coding genes are not suited for deeper phylogenetic relationships
DATING THE PLACENTAL MAMMAL DIVERSIFICATION

7 fossil calibrations
Relaxed clock

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BIOGEOGRAPHIC HISTORY OF THE PLACENTAL MAMMALS

Vicariance vs. Dispersal

Murphy et al. 2001 Science

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DATING THE PLACENTAL MAMMAL DIVERSIFICATION

Did the rate of mammals diversification increase after the K/T mass extinction?

Bininda-Emonds et al. 2007 Nature

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