

Project Report

Molecular evidence for multiple origins of Insectivora and for a new order of endemic African insectivore mammals

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ABSTRACT

Reconstructing the evolutionary history of all organisms on Earth has always been a dream for many biologists. Hence, many biologists are using an alternative technique, phylogenetic analysis, to reconstruct evolutionary history of organisms. An illustration of the evolutionary relationship among a group of organism is presented as phylogenetic tree. Here in this project we have constructed some trees using the phylogenetic methods.

INTRODUCTION

Character analysis and phylogenetic inference are the two major parts of phylogenetic analysis and are often conducted to study the evolutionary relationship among organisms. Inferring a phylogeny is an estimation procedure, in which a best estimate of the evolutionary history is made on the basis of incomplete information. Phylogenies are usually presented in a tree or trees form, which composed of nodes and branches. There are many statistical methods that can be used to reconstruct phylogenetic trees from molecular data.

In the given below paper, which we have chosen from TreeBase given the keyword “Mus Musculus”, they have constructed three trees using different methods of phylogenetic.

Michael J. Stanhope, Victor G. Waddell, Old Madsen, Wilfried De Jong, S. Blair Hedges, Gregory C. Cleven, Diana Kao and Mark S. Springer. **Molecular evidence for multiple origins of Insectivora and for a new order of endemic African insectivore mammals.** Proc. Natl. Acad. Sci. USA, Vol 95, 9967-9972, August 1998.

PMID: 9707584

http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?holding=npg&cmd=Retrieve&db=PubMed&list_uids=9707584&dopt=Abstract
www.evogenomics.org/Publications/Stanhope1998.pdf

TreeBase study accession number for these trees are S427 and TreeBase matrix accession numbers from M621 to M625.

We selected this paper because this paper includes study of different types of trees, concatenating datasets and evolutionary analysis.

Introduction to the paper

The classification of the Eutherian order Insectivora has been questioned by many people. The results of this paper shows that this classification is indeed incorrect and suggestions for corrections have been made.

Mammalian order Insectivore is that group descended from a single common ancestor and it is comprised of six families: Shrews (Soricidae), Tenrecs (Tenrecidae), Solenodons (Solenodontidae), Moles (Talpidae), Hedgehogs and Gymnures (Erinaceidae), Golden

Moles (Chrysochloridae). This paper includes opinion of an author Butler (1988), who suggested that the following morphological characteristics supported a monophyletic insectivora:

- i. Absence of cecum
- ii. Reduction of pubic symphysis
- iii. Maxillary expansion within the orbit, displacing palatine
- iv. Mobile proboscis
- v. Reduction of jugal
- vi. Hemochorial placenta

and another author MacPhee and Novacek (1993) reviewed the evidence and concluded that the characteristics (i) and (ii) support the monophyly, (iii) possibly does, (iv) to (vi) do not and two to three out of six characteristics does not support the order Insectivore. In other opinion Butler (1988) suggested that six families of insectivore often grouped into two clades of subordinal rank: the Erinaceomorpha (Hedgehogs) and Soricomorpha (Other 5). He suggested that Golden Moles and Tenrecs form a clade, Moles and Shrews cluster together, followed by Solenodons. In other opinion MacPhee and Novacek (1993) however, suggested that six families of insectivore often grouped into three clades of subordinal rank: Chrysochloromorpha (Golden Moles), Erinaceomorpha (Hedgehogs) and Soricomorpha (Other 4). This echoes earlier views that Golden Moles are a separate suborder (Broom (1916), Balsac et al. (1954) and Butler (1972). Recent Study by Springer et al. (1997) demonstrated that Golden Moles are not part of Insectivora but belong to a clade of endemic African mammals and the clade of endemic African mammals include Elephants, Hyraxes, Sea Cows, Aardvarks and Elephant Shrews. This evidence comes from a range of disparate molecular loci including nuclear AQP2, vWF and A2AB genes and mitochondrial 12S-16S rRNA genes.

Fossil record of Golden Moles suggests that the geographic distribution has been restricted to Africa. A similar inference was also made for Tenrecs. This paleontological record with the study of Butler suggests a possible common ancestry for Golden Moles and Tenrecs.

To check the variability of these studies authors of the paper used molecular phylogenetic analysis involving all families of Insectivores and complete sequences of mitochondrial 12S rRNA, 16S rRNA and tRNA-Valine genes and also sequences of nuclear genes vWF and A2AB.

Sequence alignments for all dataset have been done using ClustalW and then refined by eye and then done analysis of all dataset.

Our analysis

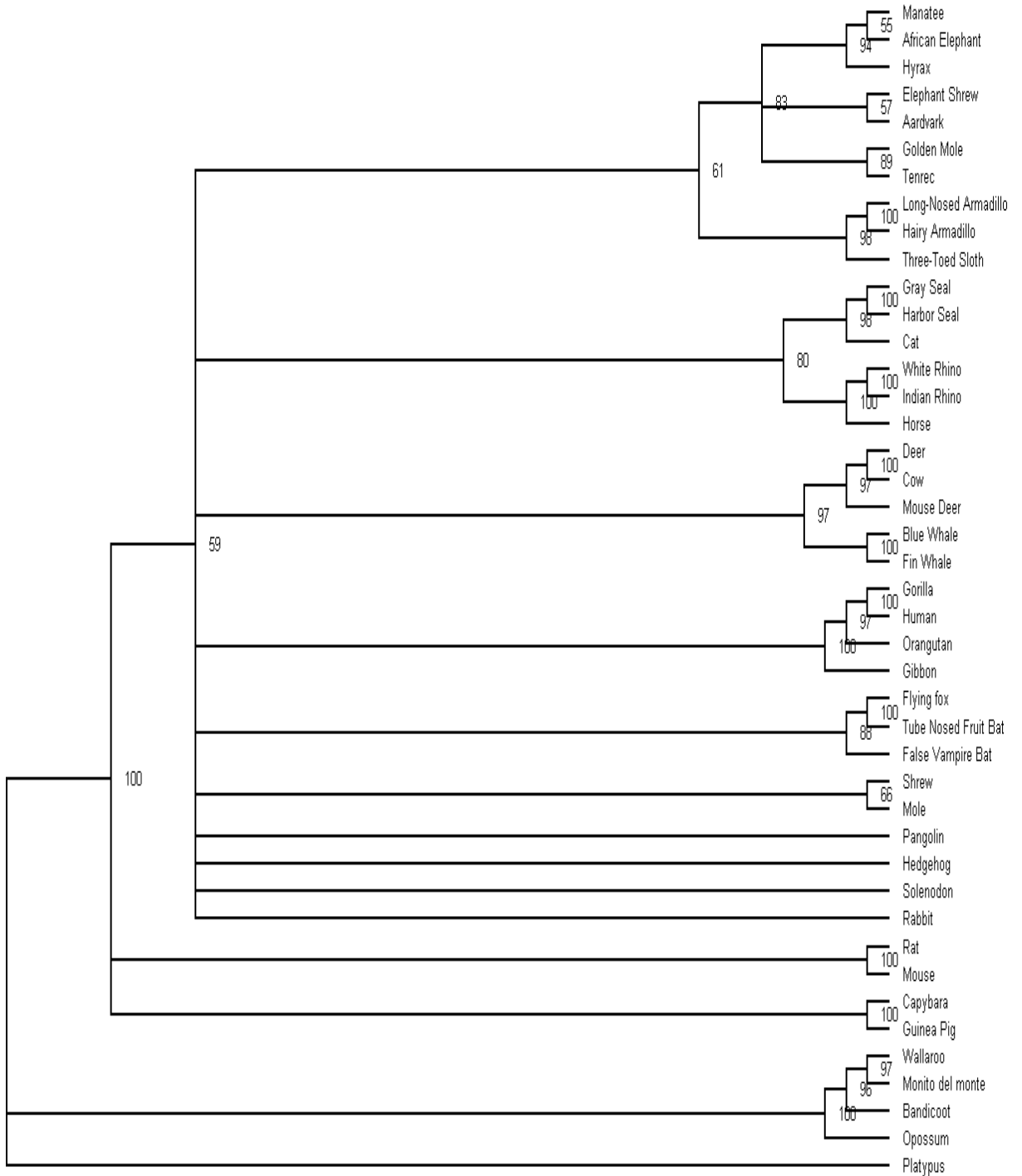
We have done analysis of three different trees using methods whichever gave in the paper.

(i) Analysis of 43 taxa

Phylogenetic tree of 43 taxa out-grouped at "Platypus" using method neighbor-joining bootstrap based on maximum likelihood distances of the 12S rRNA, tRNA-valine and 16S rRNA mitochondrial DNA sequences. Set criterion as distance and auto close to yes with

1000 replicates and saved tree in altnex format with branch length. Number of character was 2086.

We got only one best tree. Tree encompassing 16 placental orders (eutherians), 4 marsupials (Kangaroos, Australian mammals), 1 monotreme (Platypus) and includes all insectivore families. It shows 89% support for Golden Mole and Tenrec and overall 83% support for African clade.



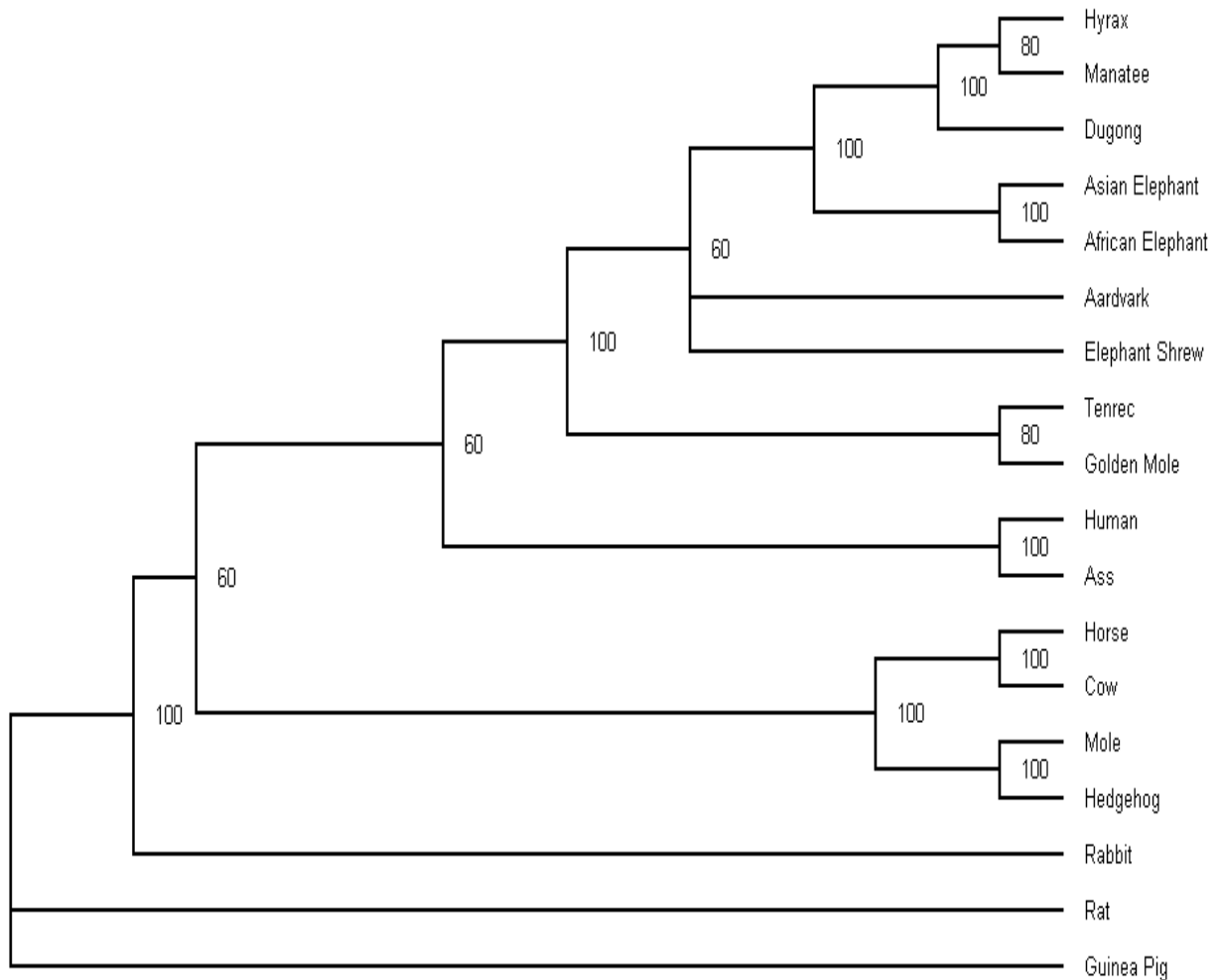
Tree of 43 taxa

(ii) Analysis of 18 taxa

Phylogenetic tree of 18 taxa out-grouped at "Rat" using method maximum likelihood bootstrap of the 12S rRNA, tRNA-Valine, 16S rRNA, vWF and A2AB. This analysis was done using combined data of mitochondrial gene and nuclear gene to get better result. First we used neighbor-joining analysis, set auto close to yes. With this analysis we used empirical base frequency, estimate transition/transversion ratio, rates as gamma and shape as estimate. Then set criterion to like using empirical base frequency, previous transition/transversion ratio, rates as gamma and shape as previous to get tree fast. We have done bootstrap using heuristic search with number of replicates 5 and saved this tree in alnexus format with branch length. Number of character for this was 5001.

We got only one best tree. This tree is encompassing 14 placental orders and 4 insectivore families. Two insectivore families, solenodons and hedgehogs which are not present in 18 taxa tree for them nuclear data is still not available.

This analysis support 100% for African clade and some support for Golden mole and Tenrec and tell that Golden mole and Tenrec are closely related to Aardvark and Elephant than to Moles and Hedgehogs.

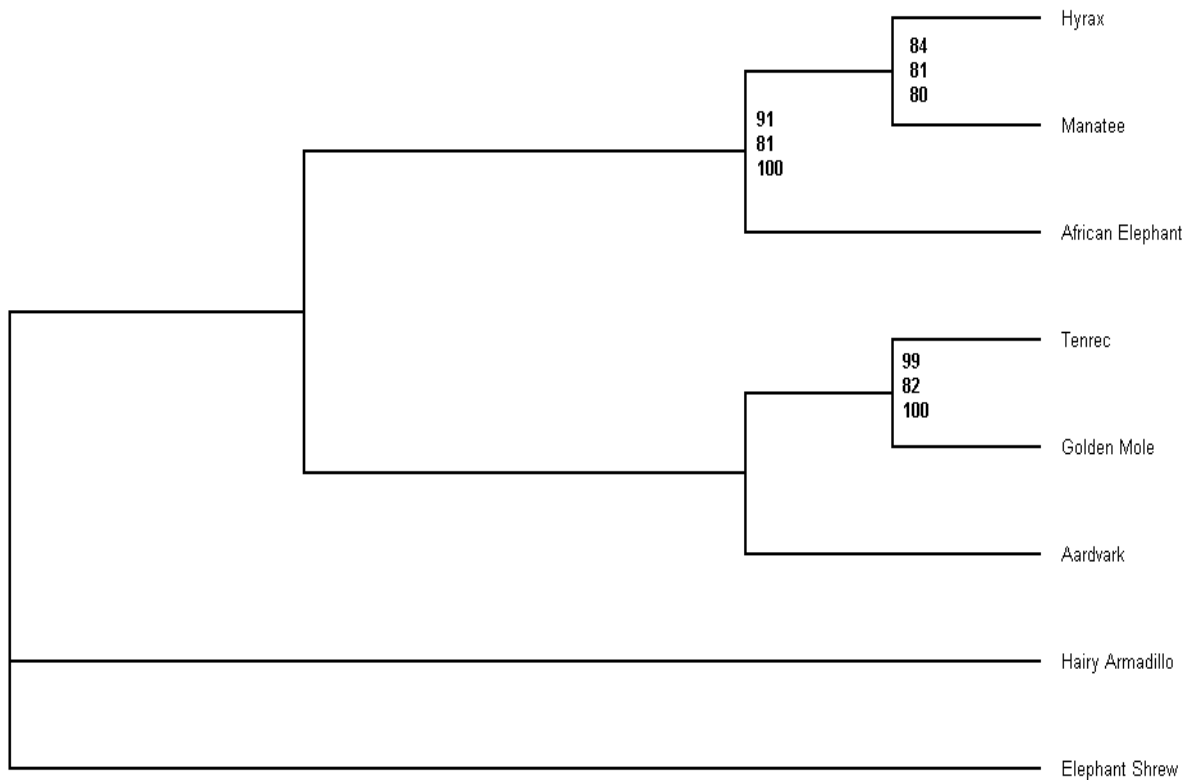


Tree of 18 taxa

(iii) Analysis of 8 taxa

Phylogenetic tree of 8 taxa out-grouped at “Hairy armadillo” using bootstrap tree of parsimony, neighbor joining with ML distances and maximum likelihood of the 12S rRNA, tRNA-Valine and 16S rRNA. In these method, set auto close to yes and criterion to parsimony, distance and like respectively. Maximum likelihood method used base frequency as empirical, estimate transition/transversion ratio, rates as gamma and shape as estimate. We gave heuristic search for both parsimony and maximum likelihood and neighbor joining for NJ with 500 replicates for NJ and parsimony but only 5 replicates for maximum likelihood and saved tree in altnex format with branch length. Number of character for this tree was 2506.

This analysis shows nearly 100% supports for Tenrec and Golden mole.



Tree of 8 Taxa

Results of Phylogenetic Analysis

Phylogenetic analysis from different methods groups the Tenrecs and Golden moles in an all-African superordinal clade comprised of Elephants, Sirenians, Hyracoids, Aardvark and Elephant shrews.

Subordinal concept of Butler and MacPhee and Novacek are not supported by our dataset and order Insectivore be partitioned and that the two African families (Golden mole and Tenrecs) should be placed in a new order Afrotheria.

