# A STUDY ON GRASSHOPPER DIVERSITY IN CHRIST COLLEGE (AUTONOUMOUS), IRINJALAKUDA


DEPARTMENT OF ZOOLOGY,
CHRIST COLLEGE (AUTONOMOUS),
IRINJALAKUDA
THRISSUR, KERALA-680 125


MARCH 2024

# A STUDY ON GRASSHOPPER DIVERSITY IN CHRIST COLLEGE IRINJALAKUDA

***Project report submitted to the University of Calicut in partial fulfillment of the requirement for the award of the Degree***

## BACHELOR OF SCIENCE
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**DEPARTMENT OF ZOOLOGY**
**CHRIST COLLEGE (AUTONOMOUS) IRINJALAKUDA**
**THRISSUR, KERALA 680125**

**Examiners:**

**1.** 

**2.**

# DECLARATION

We, Akshay K A, Aleena Mariya, Anagha Arun M A, Anagha Saibu, Anjima Jose, Mariya T J, Neethu N M, Rahma and Sandra K Shaju, do hear by declare that this project entitled "**Study on grasshopper diversity in Christ College (Autonomous), Irinjalakuda**" is a genuine record of project work done by us under the guidance of Dr. Bijoy C., Assistant Professor, Department of Zoology, Christ College (Autonomous), Irinjalakuda, and has not been submitted to any university or Institution for the Award of any Degree or Diploma.

We further declare that results presented in this work and considerations made therein, contribute in general to the advancement of knowledge in science.

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Place: Irinjalakuda

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**Dr Bijoy C.**
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# CERTIFICATE

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Place: Irinjalakuda

Date:

**Dr. Sudhikumar A. V.**

Head, Department of Zoology,

Christ College, Irinjalakuda

## ACKNOWLEDGMENTS

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## ABSTRACT

The present study is an attempt to find the diversity of grasshoppers in Christ College campus, to calculate the relative abundance of collected grasshoppers and to study their variations according to seasons and habitats. The study was carried out in four sites of Christ College campus, Irinjalakuda, Thrissur district, Kerala. Collection was done on two different seasonal period from monsoon to post monsoon. Post monsoon has the maximum species richness and monsoon shows more species diversity. According to our study, we observed 19 grasshopper species, Family Acrididae is the most abundant and Family Tetrigidae has the least abundance.

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# A Bioinformatic Study on the Molecular Evolution of Collagenases in Primates

*A project report submitted to the* ***University of Calicut*** *in partial fulfilment of the requirement for the award of the Degree*

## BACHELOR OF SCIENCE IN ZOOLOGY

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DEPARTMENT OF ZOOLOGY

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**MARCH 2024**

# CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA
# DEPARTMENT OF ZOOLOGY

## CERTIFICATE

This is to certify that the project work entitled **'A Bioinformatic Study on the Molecular Evolution of Collagenases in Primates'** is an authentic record of research work carried out by **Chandana Janardhanan, Lakshmi AP, Niharika, Salvador VS, Abhinav Krishna PV, Aysha Nedha Sakir, Mithralmajan PT, Anjima NC** and **Grace Maria Paulson** as part of BSc syllabus during the year **2023-2024** and the results of this work has not been presented for the award of any other degree/ diploma in any university.

### Certified bona fide by

**Dr. Leyon Varghese**
Supervising Guide

**Dr Sudhikumar A. V.**
Head, Department of Zoology

Date :

Place :

### Examined by

1. ______________________________

2. ______________________________

# DECLARATION

We, the following students do hereby declare that this project report entitled **'A Bioinformatic Study on the Molecular Evolution of Collagenases in Primates'** is a genuine record of the project work done by us under the guidance of Dr. Leyon Varghese, Assistant Professor, Department of Zoology, Christ College (Autonomous), Irinjalakuda and that this report has not been submitted to any University/Institution for the award of any Degree or Diploma. We further declare that the results presented in this work and considerations made therein, contribute in general to the advancement of knowledge in science and is devoid of any plagiarism.

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Place : Irinjalakuda

Date : 28-02-2024

# CONTENTS

## INTRODUCTION

The first true primates evolved around 55 million years ago or a bit earlier, near the beginning of the Eocene Epoch. Their fossils have been found in North America, Europe, and Asia. They looked different from the present day primates. Changes in gene regulation and differences in mRNA expression levels across primates have often been documented, however, it is not yet known to what extent measurements of divergence in mRNA levels reflect divergence in protein expression levels, which are probably more important in determining phenotypic differences. Collagenases, a subgroup of Matrix matalloproteases (MMPs) are a large family of zinc-dependent endopeptidases with a great affinity for several components of the extracellular matrix. The collagenases include MMP-1 (interstitial collagenase/collagenase-1), MMP-8 (neutrophil collagenase/collagenase-2), and MMP-13 (collagenase-3). These MMPs attack triple helical regions of interstitial collagen types I, II, and III at a specific single site after the Gly residue of the partial sequences Gly-(Ile or Leu)-(Ala or Leu), located about three-fourths of the distance from the N-terminus. This cleavage generates fragments approximately three-fourths and one-fourth of the size of the collagen molecules. They are distinct from a closely related gelatinases (MMP2 and 9) that are characterized by the presence of the additional fibronectin domain located inside the catalytic domain.

A phylogenetic tree or evolutionary tree is a graphical representation which shows the evolutionary history between a set of species or taxa during a specific time. In other words, it is a branching diagram or a tree showing the evolutionary relationships among various biological species or other entities based upon similarities and differences in their physical or genetic characteristics. In evolutionary biology, all life on Earth is theoretically part of a single phylogenetic tree, indicating common ancestry. Phylogenetics is indeed the study of this phylogenetic tree. The main challenge is to find a phylogenetic tree representing optimal evolutionary ancestry between a set of species or taxa. The first step in the phylogenetic tree construction (using bioinformatics tool) with a new sequence would be to use BLAST. This nifty yet powerful resource matches your sequence to the millions of sequences stored in genomic and nucleotide databases. The tool comes up with the sequences most similar to the query submitted.

It also gives insights as to the possible identity of those sequences. The results include homologues across species and in similar tissues or organisms. A sequence alignment is a way of arranging the sequences of DNA, RNA, or protein to identify regions of similarity that may be a consequence of functional, structural, or evolutionary relationships between the sequences. If two sequences in an alignment, they share a common ancestor and mismatches can be interpreted as point mutations and gaps as indels (that is, insertion or deletion mutations) introduced in one or both lineages in the time since they diverged from one another. In sequence alignments of proteins, the degree of similarity between amino acids occupying a particular position in the sequence can be interpreted as a rough measure of how conserved a particular region or sequence motif is among lineages.

Phylogenetics and sequence alignment are closely related fields due to the shared necessity of evaluating sequence relatedness. The field of phylogenetics makes extensive use of sequence alignments in the construction and interpretation of phylogenetic trees, which are used to classify the evolutionary relationships between homologous genes represented in the genomes of divergent species. The degree to which sequences in a query set differ is qualitatively related to the sequences evolutionary distance from one another. Roughly, high sequence identity suggests that the sequences in question have a comparatively young most recent common ancestor, while low identity suggests that the divergence is more ancient. This approximation, which reflects the “molecular clock” hypothesis that a roughly constant rate of evolutionary change can be used to extrapolate the elapsed time since two genes first diverged , assumes that the effects of mutation and selection are constant across sequence lineages.

## REVIEW OF LITERATURE

Primates are unique among placental mammals. Two extreme type of placentation are present in this single order. Strepsirrhines have non-invasive epitheliochorial placentation and Haplorhines have highly invasive haemochorial placentation. Strepsirrhines include Lemurs and Lorisiforms and Haplorhines include tarsiers and higher primates. Resemblance in placenta type provide the first evidence that tarsiers are linked to higher primates and distinct from lemurs and lorisiforms. Tree-shrews have endotheliochorial placentation and differ from both primate subgroups. Endotheliochorial placentation is primitive and epitheliochorial placentation is unlikely to be primitive.The recent availability of comprehensive molecular phylogenies for placental mammals has provided an independent framework to determine the most parsimonious interpretation of the evolution of placenta types (Robert Martin, 2008). In an earlier elaborate study, speciation between primates and rodents was estimated by looking at the protein coding genes of mitochondrial genomes from 31 mammals (A.D Yoder 2000). Based on paleontological data, three calibration points were used: one at 20–25 MYA for the hominoid/cercopithecoid divergence, one at 53–57 MYA for the cetacean/artiodactyl divergence, and the third at 110–130 MYA for the metatherian/eutherian divergence. Nulceotide and the amino acid sequence were looked at and results produced that were not mutually exclusive.

Even with decades of data and methods, we still can't agree on the exact evolutionary tree of higher primates (apes and humans). The most likely scenario has humans closest to chimps, but other possibilities exist. Despite numerous theories, 20 key reasons cause this uncertainty. New methods using DNA offer hope for more definitive answers. (Holmquist et al 1988). Primate phylogeny forms a solid framework for a novel depiction of diverse patterns of genome evolution among primate lineages. They are essential for future comparative genomic investigation of adaptation and selection in humans and across primates. Studies on the evolution of catarrhine primates were done using molecular, fossil and bio geographical data. It was found that the common ancestor of Old World Monkeys originated in Africa and some monkeys later moved to Asia around 10 million years ago. The study further suggested that the ancestor of the

living hominids left Africa about 20 mya and the common ancestor of the living African apes returned to Africa from Eurasia around 10 mya (Caro-Beth Stewart, Todd R Disotell 1998).

In the deep study of evolutionary roots of strepsirrhine primate labyrinthine morphology, geometric morphometric analysis showed that the labyrinthine morphology of extant strepsirrhines contains a mixed locomotor, allometric and phylogenetic signal. Discriminant analysis at the family level confirmed that labyrinthine shape is a good taxonomic marker. The results support the hypothesis that evolutionary change in labyrinthine morphology is adequately described with a random walk model, i.e. random phenotypic dispersal in morphospace (Lebrun et al, 2010). An overview of the taxonomy of New World primates based on morphology to the great number of studies based on molecular data aiming for the elucidation of the phylogeny of New World monkeys. The traditional classification of the infraorder Platyrrhini divided these primates into Cebidae and the Callitrichidae, with Callimico being allocated to either the former (Simons, 1972, Simpson, 1945) or the latter family. Hill (1957) and Hershkovitz, 1972, Hershkovitz, 1977 proposed a third family – Callimiconidae – to accommodate Callimico, because it shares characteristics that define both cebids and callitrichids. According to Hershkovitz (1977), then all New World primates should be included in one of three families – the Callitrichidae which comprised the marmosets, tamarins (Saguinus) and lion tamarins (Leontopithecus), the monotypic Callimiconidae (Callimico) and the Cebidae (Schneider et al, 2015).

In a study on molecular phylogeny and evolution of primate mitochondrial DNA, researchers determined nucleotide sequences of homologous 0.9-kb fragments of mitochondrial DNAs (mtDNAs) derived from four species of old-world monkeys, one species of new-world monkeys, and two species of prosimians. With these nucleotide sequences and homologous sequences for five species of hominoids, they constructed a phylogenetic tree for the four groups of primates. The phylogeny obtained is generally consistent with evolutionary trees constructed in previous studies. The results also suggest that the rate of nucleotide substitution for mtDNAs in hominines (human, chimpanzee, and gorilla) have slowed down compared with that for old-world monkeys (Hayasaka, 1988). Mitochondrial genomes have been used to study the

phylogenetic relationship of primates in detail. Using 454 sequencing, the study adds 32 new complete mitochondrial genomes and introduces 20 previously unrepresented genera in the primate tree. The study focuses on the New world monkeys and suborder Strepsirrhini. (Knut Finstermeier, et al 2013). The evolutionary relationships of the number of species within the genus Lepilemur were analysed with the help of a comparative cytogenetic and molecular study. The study involved the complete sequencing of the mitochondrial cytochrome b gene from 68 individuals and the results were compared to those obtained from cytogenetic studies derived from 99 specimens. The results support the classification of the eight major supportive lemur taxa as independent species. (Nicole Andriaholinirina, et al. 2006)

The relationship between the prion protiens and new world primate phylogeny have been studied. The PrP C prion protein contains 250 amino acids with some variation among species and is expressed in several cell types. Variations in the prion protein gene were observed among 16 genera of New World primates (Platyrrhini), and resulted in amino acid substitutions when compared with the human sequence. Schneider et al, 2004)

Beta-globin gene cluster of primates were analyzed to understand their evolutionary history. The rate of accumulation of mutations have also been seen to vary by a factor of 7 among different primate lineages. The study groups superfamilies Lemuroidea and Lorisoidea into suborder Strepsirhini and Tarsius and Anthropoidea into suborder Haplorhini. Evolution rates have been suggested to have slowed down over the past 25 million years of hominoid descent and has found to have happened in correlation with lengthened lifespans (Koop, BF et al 1989).

Using the SINE's methods for the analysis of mobile element based of old world monkeys. It helps to known ancestral staples. Makes them to useful genetic studies for phylogenetic studies. Alu is an helping part of it, in this methods found 285 new Alu Insertions from sixteen old world monkeys. Old world monkeys are  represent on the most diverse and largest primate families. And have  respect classification. The phylogenetic researchers are classified and grouped the old world monkeys into different classes and divisions. Mainly the subfamily  cerocopithecidae  are the most studied group.. SINEs ( short interspersed element are

used as the genetic markers this will helps to analysis several levels of phylogenetic analysis. Using both Compcompuational and PCR methods (Xing a et al, 2005).

New world monkeys represent monophyletic group. The phylogenetic relationships among new world monkeys have been extensively investigated using nucleotide sequence from different genome.In these studies still there are some unresolved issues.There are three monophyletic new world monkey families Atelidae, Cebidae and Pitheciidae. As a result Maximum parsimony analysis support the three proposed platyrrhine families. In the maximum parsimony tree, the two most closely related families are Atelidae and Cebidae.Phylogenetic relationships were reconstructed by maximum parsimony, maximum likelihood, and Bayesian approaches (JuanC Opazo et al, 2006). Anthropoid primates from the neotropics are members of parvorder Platyrrhini. The platyrrhines are also called New World monkeys. There are more than 125 species of extant New World monkeys found in approximately 15 genera. The phylogenetic relationships of these neotropical primates have been extensively studied from a molecular perspective (Derek wildman et al, 2009).

Phylogenetic trees are certainly useful for comparative studies, providing a useful framework for comparative biologists. Species evolution is not statistically independent. The fact that close relatives inherit characteristics from their common ancestor has always complicated the analysis of cross- species data. The methods in turn developed to resolve such issues, all requires resolved phylogeny. In one of the earlier studies, primates phylogeny was estimated of all 203 species of primates. Application of parsimony algorithm and bootstrapping resulted in the composite tree with 160 nodes (Purvis, Andy 1995).

In a project conducted under the support from National Cancer Institute and National Institute of Health, researchers constructed a robust phylogenetic tree of primates. The tree was constructed from the data collected of genomic sequences from 186 primates. Also outgroup species from Dermoptera, Scandentia and Lagomorpha was included. This phylogenetic representation done carefully was a notable illumination showing the pathway of primates evolution (Perelman et.al 2011).

Studies also estimated the molecular divergence dates of major primates in the context of molecular clock studies. Such studies also aid in understanding the lineage. Utilizing the genomic data, molecular divergence dates were able to be studied since alignments can be arranged and sites can be analysed for this study. Much before the molecular clock, paleontology used to provide only a mere timeframe of species evolution (Steiper et.al. 2006).

Inferring molecular phylogeny for evolutionary studies are done in non- primates as well. The molecular phylogeny of malarial parasites was recovered from mitochondrial cytochrome b gene sequences. Parsimony as well as maximum- likelihood analysis produced similar phylogenetic trees in this case. The conclusions were supported by hypothesis testing (Perkins et.al 2002). Inferring species super matrix has helped in studying macroevolutionary dynamics and even historical biogeography. The results obtained highlighted both the power as well as limitations of inferring the molecular phylogeny data to different species concepts (Springer et.al. 2012).

Over the past 60 million years, a million copies of Alu DNA have appeared in the genomes of primates. This is still an ongoing process. DNA alu repeats in the genomes of primates such as human, chimpanzee, gorilla, orangutan, baboon, rhesus, and macaque. New Alu elements arise in unique and irreversible events and appear to prevent precise excision and loss. The same insertions cannot occur independently in two species. Once the insert is genetically fixed, the DNA elements persist in all descendant lineages. Different from point mutation, the distribution of individual alu corresponds to a phylogeny only (H. Hamdi, 1999).

To resolve the debate in strepsirrhine phylogeny, 61 loci containing interspersed elements were characterized and the absence and presence of orthologous loci in the strepsirrhine panel was determined. According to these findings, it is concluded that strepsirrhines originated in Africa, and that Madagascar and Asia were colonized by immigration events (C. Roos, 2004). To investigate the phylogenetic relationships among species of New World monkeys, 1.3 kb of DNA was collected for 2 introns of the glucose-6-phosphate dehydrogenase locus encoded on the x chromosome of 24 species of New World monkeys (M. Von. Dornum, 1999).

Two molecular based approaches are used to date the initial divergence of the platyrrhine clade, a relaxed clock model using fossil record and genome datasets, and Bayesian inferences from generation time and body size to substitution rate. Fossil constraints, topology, and substitution rate are an important part of our divergence time estimates.  making an impact. Bayesian estimates using conservative and realistic fossil constraints suggest that the LCA of extant platyrrhines is 29 Ma, with a 95% confidence interval for Nodine of 27–31 Ma (SI Perez, 2013). The sequences of nuclear protein-coding gene LCAT were used to study the relationship between 19 extant rodents. The study agrees with several previous molecular and morphological studies, both concerning branching orders inside Muroidea and the bush-like radiation of rodent suprafamilial taxa. This indicates that this nuclear gene is a fitting candidate for tackling questions about rodents relationships.

The data from primates were used to reveal that the molecular clock in CpG and non-CpG sites have different nature, projecting differences in their molecular origin. Through the process, it was observed that molecular clocks are heterogeneous even within a genome. During phylogenetic analysis and while concluding divergence times using molecular data, one should be mindful that different regions of genome follow different  molecular clocks. In this study, our efforts are directed towards studying the pathway of certain collagenases in the course of evolution. Even though  some studies have been done using DNA sequences and that too in different context, in our study we focusses primarily on amino acid sequences. This is not a well researched area. Though this study we aim on providing a new work in the area of comparative biology. The results of the work may be useful in the future providing insights into how may be the few crucial changes in amino acids may have resulted into a complete new lineage.

## SIGNIFICANCE OF THE STUDY

The study of molecular evolution in primates through the comparison of amino acid sequences using bioinformatics tools represents a novel and underexplored area of research. To date, there has been a notable scarcity of studies employing bioinformatics techniques to investigate the evolutionary patterns of primates, particularly in relation to proteins such as MMP1, MMP8 and MMP13 collagenases. The selection of these collagenases for our study is particularly significant due to their split genes nature. By conducting a comparative analysis of the evolutionary trees derived from the collagenases with established standard trees, we aimed to shed light on the distinctive evolutionary trajectories of these proteins in primates. The insights obtained from this comparative study have the potential to deepen our understanding of the molecular evolution of primates and elucidate the factors driving the evolution of collagenases in this taxonomic group.

**OBJECTIVES**

1. Retrieval of relevant data (Gene/mRNA/protein sequence of collagenases of primates) from relevant reliable resources such as NIH or SIB.
2. Align the retrieved sequences using bioinformatics software to ensure they are in the correct reading frame and homologous positions are appropriately aligned.
3. Construction of the phylogenetic trees based on the Gene/mRNA/protein sequence of collagenases in primates.

## METHODOLOGY

The three human collagenases used in the study are MMP1, MMP8 and MMP13. The FASTA sequence and other details of collagenases are as below.

```
>NP_002412.1 interstitial collagenase isoform 1 MMP1 UniProt_P03956 [Homo sapiens]
MHSFPPLLLLLFWGVVSHSFPATLETQEQDVDLVQKYLEKYYNLKNDGRQVEKRRNSGPVVEKLKQMQEF
FGLKVTGKPDAETLKVMKQPRCGVPDVAQFVLTEGNPRWEQTHLTYRIENYTPDLPRADVDHAIEKAFQL
WSNVTPLTFTKVSEGQADIMISFVRGDHRDNSPFDGPGGNLAHAFQPGPGIGGDAHFDEDERWTNNFREY
NLHRVAAHELGHSLGLSHSTDIGALMYPSYTFSGDVQLAQDDIDGIQAIYGRSQNPVQPIGPQTPKACDS
KLTFDAITTIRGEVMFFKDRFYMRTNPFYPEVELNFISVFWPQLPNGLEAAYEFADRDEVRFFKGNKYWA
VQGQNVLHGYPKDIYSSFGFPRTVKHIDAALSEENTGKTYFFVANKYWRYDEYKRSMDPGYPKMIAHDFP
GIGHKVDAVFMKDGFFYFFHGTRQYKFDPKTKRILTLQKANSWFNCRKN

>NP_002415.1 neutrophil collagenase isoform 1 MMP8 UniProt_P22894 [Homo sapiens]
MFSLKTLPFLLLLHVQISKAFPVSSKEKNTKTVQDYLEKFYQLPSNQYQSTRKNGTNVIVEKLKEMQRFF
GLNVTGKPNEETLDMMKKPRCGVPDSGGFMLTPGNPKWERTNLTYRIRNYTPQLSEAEVERAIKDAFELW
SVASPLIFTRISQGEADINIAFYQRDHGDNSPFDGPNGILAHAFQPGQGIGGDAHFDAEETWTNTSANYN
LFLVAAHEFGHSLGLAHSSDPGALMYPNYAFRETSNYSLPQDDIDGIQAIYGLSSNPIQPTGPSTPKPCD
PSLTFDAITTLRGEILFFKDRYFWRRHPQLQRVEMNFISLFWPSLPTGIQAAYEDFDRDLIFLFKGNQYW
ALSGYDILQGYPKDISNYGFPSSVQAIDAAVFYRSKTYFFVNDQFWRYDNQRQFMEPGYPKSISGAFPGI
ESKVDAVFQQEHFFHVFSGPRYYAFDLIAQRVTRVARGNKWLNCRYG

>NP_002418.1 collagenase 3 MMP13 UniProt_P45452 [Homo sapiens]
MHPGVLAAFLFLSWTHCRALPLPSGGDEDDLSEEDLQFAERYLRSYYHPTNLAGILKENAASSMTERLRE
MQSFFGLEVTGKLDDNTLDVMKKPRCGVPDVGEYNVFPRTLKWSKMNLTYRIVNYTPDMTHSEVEKAFKK
AFKVWSDVTPLNFTRLHDGIADIMISFGIKEHGDFYPFDGPSGLLAHAFPPGPNYGGDAHFDDDETWTSS
SKGYNLFLVAAHEFGHSLGLDHSKDPGALMFPIYTYTGKSHFMLPDDDVQGIQSLYGPGDEDPNPKHPKT
PDKCDPSLSLDAITSLRGETMIFKDRFFWRLHPQQVDAELFLTKSFWPELPNRIDAAYEHPSHDLIFIFR
GRKFWALNGYDILEGYPKKISELGLPKEVKKISAAVHFEDTGKTLLFSGNQVWRYDDTNHIMDKDYPRLI
EEDFPGIGDKVDAVYEKNGYIYFFNGPIQFEYSIWSNRIVRVMPANSILWC
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The study on phylogenetic relationships in primates was conducted using this amino acid sequences to do the BLAST (Basic Local Alignment Search Tool) analysis in the NCBI Genebank database. The most suitable amino acid sequences for each primate species were then carefully selected from sequences delivered by the server. An out group was chosen which in our study was the Mus musculus of the order Rodentia.

The selected sequences were then compared with that of the out group and a phylogenetic tree was constructed based on the degree of divergence. The software used for constructing phylogenetic tree was  Molecular Evolutionary Genetics Analysis (MEGA).

## RESULTS AND DISCUSSIONS

The research article titled "A Molecular Phylogeny of Living Primates" published in 2011, established a robust and widely accepted framework for understanding primate evolution. This phylogenetic tree served as a standard reference for our study, allowing us to compare our data and draw conclusions. According to this article Order Primata is subdivided into two major Suborder Haplorrhini and Strepsirrhini. The remaining primate phylogeny is classified as follows.

**Suborder Haplorrhini** further divides into Infraorders, namely Simiiformes and Tarsiiformes. Tarsiiforme include only one Family (Tarsiidae) with only two extant species. Simiiformes is subdivided into Parvorders Catarrhini (Old world) and Platyrrhini (New world).

Parvorder Catarrhini in turn consist of the Superfamilies Cercopithecoidea and Hominoidea. Cercopithecoidea has only one extant Family *viz*. Cercopithecidae but the organisms of Superfamily Hominoidea is further divided into two Families, *viz*, Hylobatidae and Hominidae. Family Cercopithecidae has two Subfamilies such as Cercopithecinae and Colobinae. Family Hylobatidae include all Gibbon Genus and there is no further subgrouping. Hominidae on the other hand has two Subfamilies *viz.* Homininae and Ponginae. Subfamily Ponginae include all species of Orangutang and all o there Greater Apes and Humans are included in Homininae. Subfamily Cercopithecinae is subdivided into two Tribes namely, Papionini and Cercopithecini whereas Colobinae is subdivided into two Tribes namely Presbytini and Colobini.

Parvorders Platyrrhini on the other hand is divided directly into three Families such as Cebidae, Atelidae and Pitheciidae. Family Cebidae has four Subfamilies namely, Callitrichinae, Aotinae, Cebinae and Saimirinae. Fly. Atelidae has two Subfamilies (Atelinae & Alouattinae) so also Fly. Pitheciidae (Callicebinae & Pitheciinae).

**Suborder Strepsirrhini** is divided into the Infraorders Lemuriformes, Chiromyiformes and Lorisiformes. Unlike Haplorrhini, there is no observed grouping of these Infraorders into Parvorders or Superfamilies. Instead, they are grouped into Families such as Lepilemuride,

Cheirogaleidae, Indriidae, Lemuridae, Daubentoniidae, Lorisidae and Galagidae. Further subdivision within Lorisidae includes the subfamilies Lorisinae and Perodicticinae.

**<u>MMP-</u>1**

The phylogenetic tree for the MMP1 gene in primates was meticulously constructed, employing an analysis of amino acid sequences from various primate species. To enhance our phylogenetic analysis, *Mus musculus* was strategically employed as the outgroup, providing a reference point for the evolutionary relationships within the MMP1 collagenase gene among primates. Our investigation also utilized a well established standard phylogenetic tree for primates, derived from genomic sequences across diverse species, serving as a foundational reference for elucidating the evolutionary dynamics of collagenase genes within our study group (Reference). The results obtained regarding the evolutionary pathway of the MMP1 gene include the following observations:

- *Carlito syrichta*: Our findings indicate that MMP1 gene of *Carlito syrichta,* a tarsier species primarily descended with minimal changes from the common ancestor of all primates indicating an ancient ancestry. Although this tree suggests such an ancient ancestry and early divergence of *Carlito syrichta* from the early primate stock, a comparison with the established tree reveals that tarsiers diverged from a common stock of strepsirrhini - more primitive primate. It is therefore inferred that the MMP1 gene remained with minimum changes in the tarsiers as compared to strepsirrhini primates.

- *Hominidae:* In our tree constructed using MMP1 the common ancestor of *Pan* and *Homo*, along with the common ancestor of *Gorilla* and *Pongo,* collectively share a common ancestor. Gibbons, including *Nomascus* and *Symphalangus,* share a common ancestor that along with the common ancestor of *Hominidae* were descended from a common stock of interbreeding ape like animal. Upon analysing the standard phylogenetic tree, a similar pattern emerges, with *Homo* and *Pan* sharing a common ancestor. This common ancestor was also ancestral to present day *Gorilla,* from which the *Pongo* ancestry might have diverged. However, the discrepancy in our results suggestive of *Gorilla* sharing a recent

common ancestor with *Pongo,* but not with *Homo* or *Pan*. This suggests a simultaneous origin for *Gorilla* and *Pongo*, contrary to the standard tree's assertion of *Gorilla*'s more recent evolution compared to *Pongo*. Further analysis of the amino acid sequences are required to see if the *Homo-Pan* group has any common advantage with the kind of changes on the MMP1 protein over the *Gorilla-Pongo* group.

- Old World Monkeys: Our results indicate that, three groups *viz. Macaca*, *Papio* and *Theropithecus* are equally distant from a common ancestor, while *Colobus* and *Trachypithecus* share another common ancestor. The standard phylogenetic tree confirms this, revealing a common ancestor for *Colobus* and *Trachypithecus,* along with the ancestor of *Macaca, Papio* and *Theropithecus.* But with *Macaca, Papio* and *Theropithecus,* our results differ from the standard tree. While standard tree implies that *Papio* and *Theropithecus* had a common ancestor after the common ancestry shared with *Macaca,* our tree do not mention between an ancestor common to both *Papio* and *Theropithecus.* Though the changes are minimal, it wold be interesting to look for the their sequences for further analysis.

- New World Monkeys: Our findings in New World Monkeys suggest that *Saimiri* and *Cebus* share a most recent common ancestor, while *Aotus* share a common ancestor with this lineage. This is consistent with both our phylogenetic tree and the standards phylogenetic tree. Furthermore, *Nycticebus* and *Otolemur* share a common ancestor, and *Lemur* and *Microcebus* also share a common ancestor. The common ancestors of these pairs collectively had a single common ancestor, aligning with observations on the standard phylogenetic tree.

**MMP-8**

- *Hominidae*: In the phylogenetic tree derived from MMP8 sequence data, it was observed that the common ancestor of Homo and Gorilla shares ancestry with the common ancestor of Pan. This collective ancestry is further linked to the common ancestor of Hominidae, which is shared with Gibbons. In contrast to the standard phylogenetic tree, where Pan and Homo share an ancestor ancestral to present-day Gorilla, our results suggest the potential existence of an alternative evolutionary pathway for these three species. A comprehensive investigation is recommended to explore the implications of this alternative pathway further.

- Loris: Our findings indicate that the Loris shares a common ancestor with Hominidae, Tarsier, Gibbons, New World, and Old World monkeys, all of which originate from the Strepsirrhini primates. Similarly, Lemurs are shown to arise from Haplorrhini primates. Discrepancies with the standard phylogenetic tree, which suggests a more recent common ancestry for Lemurs and Loris, necessitate further analysis to validate the proposed ancestral pattern among the descendants of these two major groups of early primates.

- New World Monkeys: Upon examining the lineage of New World monkeys, it is observed that recent descendants Aotus and Saimiri share a common ancestor, which is further linked to the common ancestor of Cebus and Sapajus. This lineage can be traced back to early Strepsirrhini primates. Although minor differences are noted compared to the standard phylogenetic tree, where an ancestor common to Saimiri and Cebus precedes the common ancestry with Aotus, further analysis is warranted to explore these nuances.

- Old World Monkeys: Our analysis reveals that Papio and Theropithecus share a common ancestor, which is connected to the common ancestor of Macaca. This ancestral lineage can be traced back to an ancestor shared with the common ancestor of Piliocolobus and Trachypithecus. The observed pattern aligns with the standard phylogenetic tree in the lineage of Old World monkeys.

**MMP-13**

- *Hominidae*: When we comparing the phylogenetic tree made by us on the basis of MMP13 and the standard one, the Nomascus leucogenys & Symphalongus syndactylus (Hylobatidae) share a recent common ancestor and they together share common ancestor with old world monkeys in MMP13. But, when we comparing this with the standard one we can observe that the Hylobatidae sharing common ancestor with Hominidae.

- New World Monkeys: Our findings in new world monkeys by comparing the Standard phylogenetic tree with the phylogenetic tree of MMP13 depicting that, in the phylogenetic tree of MMP13, the Cebus imitator & Sapajus apella shares a recent common ancestor and these group share a common ancestor with Samiri bolivensis and all of these collectively share a common ancestor with Aotus nancymaae. When we comparing this with the standard phylogenetic tree Cebus imitator & Samiri bolivensis directly arrived from a common ancestor.

- Old World Monkeys: By analysing the group Cercopithecidae in the tree of MMP13, Papio Anubis & Theropithecis gelada share a recent common ancestor and they together share a common ancestor with Macaca group, Piliocolobus tephrosceles & Trachypithecus francoisi directly. But when we comparing this with the standard phylogenetic tree, they where not sharing a common ancestor directly, all of them share a common ancestor with other species recently, but all of them primitively share a common ancestor.

Alignment: D:\Leyon\Evolution\MMP1\1-tree_for_seaview.txt
Seaview [blocks=10 fontsize=12 A4-landscape] on Wed Jan 31 07:26:41 2024

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                              1
Homo_sapiens                  MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Mus_musculus                  MPSLP---LL LLLWAASSYS FPVFHNGDRQ NVETVWKYLE NYYNL---GK NMQAKNVNGK EMMAEKLRQM
Aotus_nancymaae               MHSYPP-LLL LLFWGVVSHG FPATLETQEQ DVEIVQKYLE QYYNLKNDGK QVEKKRSSGP --VVEKLKQM
Carlito_syrichta              MPSLP--LVL MLLWAVGSRG FPATSETREQ DVEIVQKYLE NYFNLKNDGK QFEKQRHSAP --VVEKLKEM
Cebus_imitator                MHSYPL-LLL LLFWGVVSHG FPATLETQEQ DVEIVQKYLE QYYNLKNDGK QVEKQRNSGP --VVEKLKQM
Gorilla_gorilla               MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Lemur_catta                   MPSFS--LLL LLLWGLGSHG FPAIPETQEQ DVEIVQKYLE NYYDLKNVGK QIEKKRSSGS --VVEKLKQM
Macaca_mulatta                MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDFVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Macaca_nemestrina             MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Microcebus_murinus            MPRFS--LLL LLLWSLGSHG LPVAPETQEQ DVEIVQKYLE NYYDLKNDGK QIEKKRNSGP --VVEKLKQM
Nomascus_leucogenys           MHSFPPLLLL LLFWSVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGL --VVEKLKQM
Nycticebus_coucang            MPSF---LLL LLLWGLGSHA FPAIPEPQEQ DVEIVQKYLE NYYDLKNDGS QIERKRNSGP --VVEKLKQM
Otolemur_garnettii            MSSFP--LLL LLLWGLGSHA LPVTPETQEQ DVEIVQKYLE NYYDLKNDGM QIERKRNSGP --VVEKLKQM
Pan_paniscus                  MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Pan_troglodytes               MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Papio_anubis                  MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Piliocolobus_tephrosceles     MHSFPPLLLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVQKQRNSGP --VVEKLKQM
Pongo_abelii                  MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Pongo_pygmaeus                MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Saimiri_boliviensis           MHSYPP-LLL LLFWSVVSHG FPATLETQEQ DVEIVQKYLE QYYDLKNDGK QVEKQRNSGP --VVEKLKQM
Sapajus_apella                MHSYPL-LLL LLFWGVVSHG FPATLETQEQ DVEIVQKYLE QYYNLKNDGK QVEKQRNSGP --VVEKLKQM
Symphalangus_syndactylus      MHSFPPLLLL LLFWSVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGL --VVEKLKQM
Theropithecus_gelada          MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Trachypithecus_francoisi      MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDRR QVEKQRNSGP --VVEKLKQM
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                            71
Homo_sapiens                QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Mus_musculus                QQLFGLKVTG NSDPETLRAM KKPRCGVPDV APYAITHNNP RWTKTHLTYS ILNYTPYLPK AVVEDAIARA
Aotus_nancymaae             QEFFGLKVTG KPDAETLNVM KQPRCGVPDV ARFVLTEGNP RWEKTHLTYR IENYTPDLPR ADVDQAIEKA
Carlito_syrichta            QKFFGLKVTG KPDPETLKVM KQPRCGVPDV AQFVLTEGNP RWQKTDLTYR IENYTPDLPK AEVDRAIEKA
Cebus_imitator              QEFFGLKVTG KPDAETLKVM KQPRCGVPDV ARFVLTEGNP RWKKTHLTYR IENYTPDLPR SDVDHAIEKA
Gorilla_gorilla             QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Lemur_catta                 QEFFGLKVTG KPDTETLKVM KQPRCGVPDV ARFVLTQGNP RWEQTHLTYR IENYTPDLPR ADVDLAIEKA
Macaca_mulatta              QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR AAVDQAIEKA
Macaca_nemestrina           QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR AAVDQAIEKG
Microcebus_murinus          QEFFGLKVTG KPDTETLKVM KQPRCGVPDV ARFVLTQGNP RWEKTHLTYR IENYTPDLSR ADVDHAIEKA
Nomascus_leucogenys         QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTAGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Nycticebus_coucang          QEFFGLKVTG TPDTETLKVM KQPRCGVPDV ARFALTPGNP RWEQTHLTYR IENYTPDLPR ADVDDAIEKA
Otolemur_garnettii          QEFFGLKVTG TPDTETLKVM KQPRCGVPDV ARFVLTQGNP RWEQTHLTYR IENYTPDLPK ADVDDAIEKA
Pan_paniscus                QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIAKA
Pan_troglodytes             QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIAKA
Papio_anubis                QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR AAVDQAIEKA
Piliocolobus_tephrosceles   QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDRAIEKA
Pongo_abelii                QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Pongo_pygmaeus              QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Saimiri_boliviensis         QEFFGLKVTG KPDAETLNVM KQARCGVPDV ARFVLTEGNP RWEKTHLTYR IENYTPDLRR ADVDHAIEKA
Sapajus_apella              QEFFGLKVTG KPDAETLKVM KQPRCGVPDV ARFVLTEGNP RWEKTHLTYR IENYTPDLPR SDVDHAIEKA
Symphalangus_syndactylus    QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTAGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Theropithecus_gelada        QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR AAVDQAIEKA
Trachypithecus_francoisi    QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDRAIEKA
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                              141
Homo_sapiens                  FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Mus_musculus                  FRVWSDVTPL TFQRVFEEEG DIVLSFHRGD HGDNNPFDGP NYKLAHTFQP GPGLGGDVHY DLDETWTNSS
Aotus_nancymaae               FQLWSNVTPL TFTKVPKGQA DIMISFVRGD HQDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDETWTNNF
Carlito_syrichta              FQLWSNASPL RFTKVVEGQA DIMISFVRGD HQDNSPFYGP GENLAHAFQP GPNIGGDAHF DEDETWTNNI
Cebus_imitator                FQLWSNVTPL TFTKVPKGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GSGIGGDAHF DEDETWTNNF
Gorilla_gorilla               FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Lemur_catta                   FQLWSNASPL TFTKVFEGQA DIMISFVRGD HQDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDEQWTSDS
Macaca_mulatta                FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Macaca_nemestrina             FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Microcebus_murinus            FQLWSNASPL TFTRVFEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDEQWTNNF
Nomascus_leucogenys           FKLWSNVTPL TFTKVSEGQA DIMISFVRGD HQDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Nycticebus_coucang            FRLWSNASPL TFTKVFQGQA DIMISFVRGD HQDNSPFDGP GGNLAHAFQP GPGIGGDTHF DEDERWTNNL
Otolemur_garnettii            FQLWSNASPL TFTKVFQGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDEKWTNNL
Pan_paniscus                  FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Pan_troglodytes               FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Papio_anubis                  FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Piliocolobus_tephrosceles     FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Pongo_abelii                  FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Pongo_pygmaeus                FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Saimiri_boliviensis           FQLWSNVTPL TFTKVPKGQA DIMISFVRGD HQDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDETWTNNF
Sapajus_apella                FQLWSNVTPL TFTKVPKGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDETWTNNF
Symphalangus_syndactylus      FKLWSDVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DDDERWTNNF
Theropithecus_gelada          FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Trachypithecus_francoisi      FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
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                              211
Homo_sapiens                  REYNLHRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Mus_musculus                  ENFNLFYVTA HELGHSLGLT HSSDIGALMF PSYTWYTEDF VLNQDDINRI QDLYGPSPNP IQPTGATTPH
Aotus_nancymaae               REYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGKSQNP VQPTGPQTPQ
Carlito_syrichta              QNYNLYRVAA HEFGHSLGLS HSTDIGALMY PTYT-YSGDV QLAQDDIDGI QAIYGPSQNP IQPTGPQTPQ
Cebus_imitator                RGYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGQSPNP VQPTGPQTPQ
Gorilla_gorilla               REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Lemur_catta                   RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYT-FSGDV QLAQDDIDGI QAIYGPSQNP NQPTGPQTPQ
Macaca_mulatta                REYNLYRVAA HEFGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Macaca_nemestrina             REYNLYRVAA HELGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Microcebus_murinus            RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYA-FSGDV QLAQDDIDGI QAIYGPSQNP NQPIGPQTPQ
Nomascus_leucogenys           REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Nycticebus_coucang            RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYA-FSGEV ELAQDDIDGI QAIYGPSQNP IQPIGPQTPQ
Otolemur_garnettii            RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYA-FSGEV ELAQDDIDGI QAIYGPSQNP VQPTGPQTPQ
Pan_paniscus                  REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGHSQNP VQPIGPQTPK
Pan_troglodytes               REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Papio_anubis                  REYNLYRVAA HELGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Piliocolobus_tephrosceles     REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLSQDDIDGI QAIYGGSQNP VQPTGPQTPK
Pongo_abelii                  REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGPSQNP VQPIGPQTPK
Pongo_pygmaeus                REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGPSQNP VQPIGPQTPK
Saimiri_boliviensis           REYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGPSPNP VQPTGPQTPQ
Sapajus_apella                REYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGQSPNP VQPTGPQTPQ
Symphalangus_syndactylus      REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Theropithecus_gelada          REYNLYRVAA HELGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Trachypithecus_francoisi      REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
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                                 281
Homo_sapiens                     ACDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Mus_musculus                     PCNGDLTFDA ITTFRGEVFF FKGRFYIRVN RFMPEPELNL IGILWPNLPV KLDAAYEASM IDQVRYFKGS
Aotus_nancymaae                  VCDSKLTFDA ITTIRGEVFF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Carlito_syrichta                 ACDSKISFDA VTTIRGEVMF FKDRFFMRTH PSYPEADLNF ISDFWPLLPN GLEAAYEDAG RDQVRFFKGY
Cebus_imitator                   VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PYYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Gorilla_gorilla                  VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLQAAYEFAD RDEVRFFKGN
Lemur_catta                      VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPS GLEAAYEVAS RDEVRFFKGN
Macaca_mulatta                   VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Macaca_nemestrina                VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Microcebus_murinus               VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF VSVFWPQLPT GLEAAYEVAD RDEVRFFKGN
Nomascus_leucogenys              VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Nycticebus_coucang               VCDSKLTFDA VTTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPS GLEAAYEVVD RDEIRFFKGN
Otolemur_garnettii               VCDSKLTFDA VTTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEVAD RDEVRFFKGN
Pan_paniscus                     VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PSYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Pan_troglodytes                  VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Papio_anubis                     VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Piliocolobus_tephrosceles        VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLQAAYEFAE RDEVRFFKGN
Pongo_abelii                     VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Pongo_pygmaeus                   VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Saimiri_boliviensis              VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Sapajus_apella                   VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PYYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Symphalangus_syndactylus         VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGK
Theropithecus_gelada             VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Trachypithecus_francoisi         VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLQAAYEFAD RDEVRFFKGN
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                              351
Homo_sapiens                  KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Mus_musculus                  KVWAVQEQSV LRGFPRDIHS FFGFPSNVTH IDAAVCEEET GKTYFFVDHM YWRYDENTQS MDPGYPRLTA
Aotus_nancymaae               KYWAAQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDAGYPKMIA
Carlito_syrichta              RFWAVQGQDV LRGYPQDIYS SYGFPRTVKH IDAAVFEEET GKTFFFVGNK YWRYDEYKRS MDVGYPKMIA
Cebus_imitator                KYWAVQGQNV LYGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDAGYPKKIA
Gorilla_gorilla               KYWAVQGQNM LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDPGYPKMIA
Lemur_catta                   KYWAVQGQNV LPGYPKDIYR SFGFPRTVKH IDAAISEEDT GKTYFFVANK YWRYDEYKQS MDTGYPKKLA
Macaca_mulatta                KYWAVQGQNV LPGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Macaca_nemestrina             KYWAVQGQNV LPGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Microcebus_murinus            KYWAVQGQNV LPGYPKDIYK SFGFPKTVKH IDAAVSEEDT GKTYFFVANK YWRYDEYKQS MDAGYPKMIA
Nomascus_leucogenys           KYWAVQGQNV LHGYPKDIYS SFGFPRTVKR INAALSEENT GKTYFFVAKK YWRYDEYKRS MDPGYPKMIA
Nycticebus_coucang            KYWAVRGQDV LHGYPKDISS SFGFPRTVKH VDAAVSEEET GKTYFFVANK YWRYDENKQS MDTGYPKMIA
Otolemur_garnettii            KYWAVRGPDV LHGYPKDISS SFGFPRTVKH VDAAVSEEET GKTYFFVANK YWRYDENKQS MDTGYPKTIA
Pan_paniscus                  KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Pan_troglodytes               KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Papio_anubis                  KYWAVQGQNV LPGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIS
Piliocolobus_tephrosceles     KYWAVQGQNV LRGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Pongo_abelii                  KYWAVQGQNM LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEHKRS MDPGYPKMIA
Pongo_pygmaeus                KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Saimiri_boliviensis           KYWAVQGQNV LYGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDAGYPKMIA
Sapajus_apella                KYWAVQGQNV LYGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDAGYPKKIA
Symphalangus_syndactylus      KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVAKK YWRYDEYKRS MDPGYPKMIA
Theropithecus_gelada          KYWAVQGQNV LPGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK CWRYDEYKRS MDPGYPKMIA
Trachypithecus_francoisi      KYWAVQGQNV LRGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYERS MDPGYPKMIA
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Homo_sapiens                  HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Mus_musculus                  EDFPGIDDKV DDVFQKGENF YFFHQSVQHR FNLQIRRVDD SRDSSTWFNC ---
Aotus_nancymaae               DDFPGIGHKV DAVFMKDGFF YFFHKTRQYK FEPETKRILT LQKANSWFNC RKN
Carlito_syrichta              HGFPGIGHKV DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKN
Cebus_imitator                HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Gorilla_gorilla               HDFPGIGHKV DAVFMKDGFF YFFRGRRQYK FDPETKRILT LQKANSWFNC RKN
Lemur_catta                   LDFPGIGHKI DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKK
Macaca_mulatta                HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Macaca_nemestrina             HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Microcebus_murinus            HDFPGIGHKI DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKN
Nomascus_leucogenys           HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Nycticebus_coucang            HDFPGIGHKV DAVFKKDEFF YFFHGTRQYK FDLKTKRILT LLKANSWFNC RKH
Otolemur_garnettii            HDFPGIGHKV DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKH
Pan_paniscus                  HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Pan_troglodytes               HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Papio_anubis                  HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Piliocolobus_tephrosceles     HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Pongo_abelii                  HDFPGIGHKV DAVFTKDGFF YFFHGTRQYK FDPETKRILT LQKANSWFNC RKN
Pongo_pygmaeus                HDFPGIGHKV DAVFTKDGFF YFFHGTRQYK FDPETKRILT LQKANSWFNC RKN
Saimiri_boliviensis           HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Sapajus_apella                HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Symphalangus_syndactylus      HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Theropithecus_gelada          HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Trachypithecus_francoisi      HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
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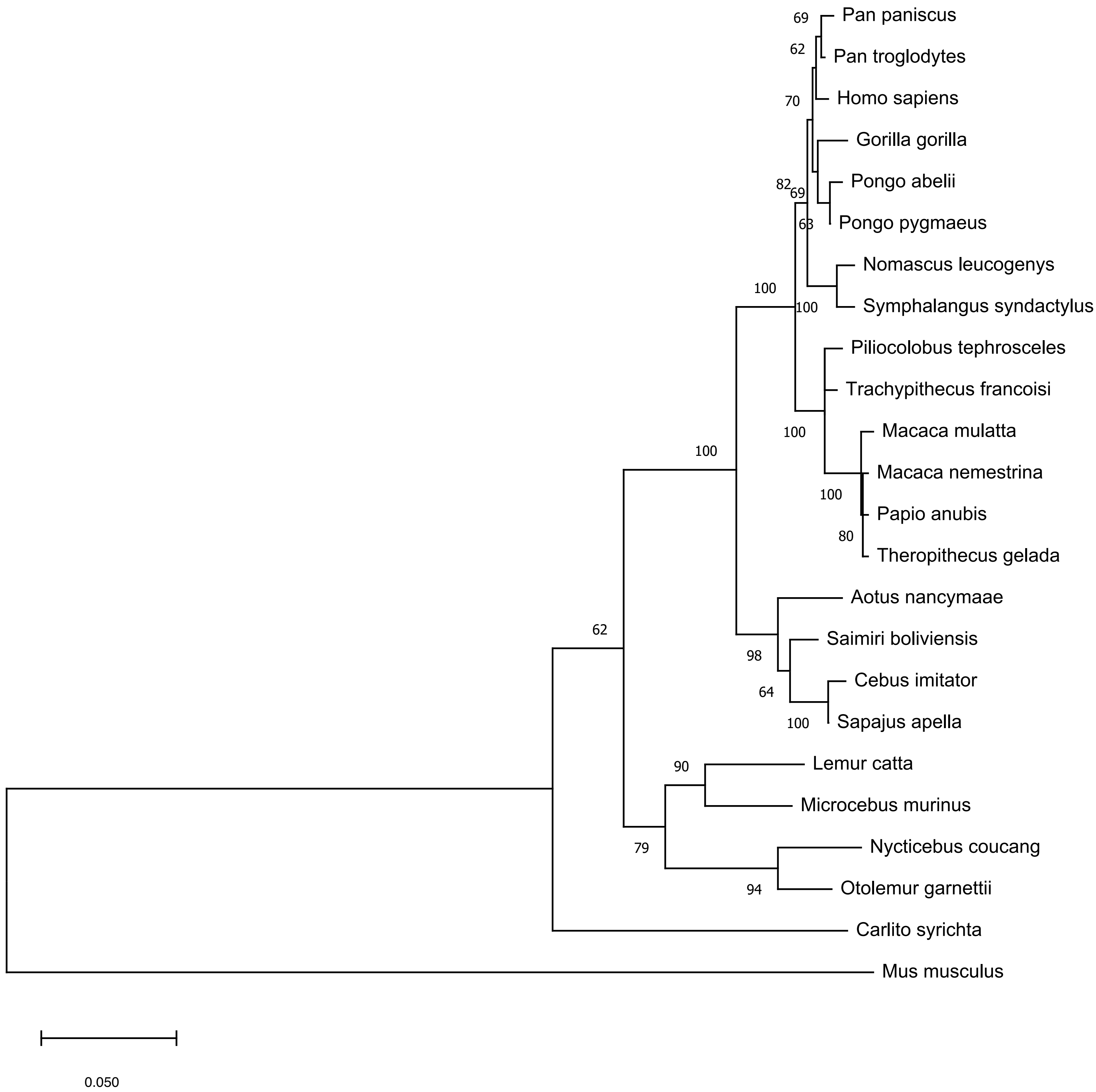
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Pan troglodytes
Homo sapiens
Gorilla gorilla
Pongo abelii
Pongo pygmaeus
Nomascus leucogenys
Symphalangus syndactylus
Piliocolobus tephrosceles
Trachypithecus francoisi
Macaca mulatta
Macaca nemestrina
Papio anubis
Theropithecus gelada
Aotus nancymaae
Saimiri boliviensis
Cebus imitator
Sapajus apella
Lemur catta
Microcebus murinus
Nycticebus coucang
Otolemur garnettii
Carlito syrichta
Mus musculus
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Mus_musculus                  MFRLKTLPLL IFLHTQLANA FPVPEHLEEK NIKTAE---- ------NYLR KFYNLPSNQF RSSRN--ATM
Aotus_nancymaae               MFCLKTLPFL LLLHVQISKA FPVSS--KEK DTKIVQ---- ------DYLE KFYQLPSNQY QSIRKNSINM
Carlito_syrichta              MFSLQMLLFL LLLHMQVATA FPTPS--EEK STTMVQ---- ------DYLE KFYQLPSSRY RSARKNSTSM
Cebus_imitator                MFCLKTLPFL LLLHVQISKA FPVSS--KEK DTKIVQ---- ------DYLE KFYQLPSNQH QSIRKNSINM
Gorilla_gorilla               MFSLKTLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- ------DYLE KFYQLPSNQY QSTRKNGTNV
Lemur_catta                   MFYLKTLPFL LLLHMELSKA FPVPS--EEK NAKIVQ---- ------DYLE KFYRLPSNQY RTARKNSPST
Macaca_mulatta                MFSLKMLLFL LLLHVQISKA FPVSS--KEE NTKIVQ---- ------DYLE KFYQLPSNQY QSTRKNGTSM
Macaca_nemestrina             ---------- -------MQQ IP-------- QEKSIN---- ------DYLE KFYQLPSNQY QSTRKNGTSM
Microcebus_murinus            MFCLKTLPLL LLLHMELSKA FPVPS--EGR NAKIVQ---- ------DYLE KFYRLPSNQY RTARKNSASM
Nomascus_leucogenys           MFALKTLPFL LLLHVHISKA FPVSS--KEK NTKIVQ---- ------DYLE KFYQLPSNQY QSTRKNGTNV
Nycticebus_coucang            MFCLKTLLFL LLLHVQLSKT FPVVS--AEK NTKLIQ---- ------DYLE KFYQLPSNRY RTSRKNSTTM
Otolemur_garnettii            MFRLKTLVFL LLLHVPLSKT FPVVS--AEK NTKLIQ---- ------DYLE KFYQLPSNRY RTSRKNSTTM
Pan_paniscus                  MFSLKTLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- ------DYLE KFYQLPSNQY QSTRKNGTNV
Pan_troglodytes               MFSLKMLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- ------DYLE KFYQLPSNQY QSTRKNGTNV
Papio_anubis                  MFSLKMLPFL LLLHVQISKA FPVSS--KEE NTKIVQ---- ------DYLE KFYQLPSNQY QSMRKNGTSM
Piliocolobus_tephrosceles     MFSLKTLPFL FLLHVQISKA FPVSS--KEE NTKIVQ---- ------DYLE KFYQLPSNQY QSTRKNGTSM
Pongo_abelii                  MFSLKTLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- ------DYLE KFYQLPSNQY QSTRKNGTNV
Pongo_pygmaeus                -MCRFPRPFL YLLKRKIQKL FSTRP--SQK PTRCSHLILD FPASKIDYLE KFYQLPSNQY QSTRKNGTNV
Saimiri_boliviensis           MFCLKRLPFL LLLHVQISKA FPVSF--KEK DTKIVQ---- ------DYLE KFYQLPSNQY QSIRKNSINM
Sapajus_apella                MFCLKTLPFL LLLHVQISKA FPVSS--KEK DTKIVQ---- ------DYLE KFYQLPSNQY QSIRKNSINM
Symphalangus_syndactylus      MFALKTLPFL LLLHVHISKA FPVSS--KEK NTKIVQ---- ------DYLE KFYQLPSNQY QSTRKNGTNV
Theropithecus_gelada          MFSLKMLPFL LLLHVQISKA FPVSS--KEE NTKIVQ---- ------DYLE KFYQLPSNQY QSTRKNGTSM
Trachypithecus_francoisi      MFSLKTLPFL LLLHVQISKA FPLSS--KEE NTKIVQ---- ------DYLE KFYQLPSNQY QSTRKNGTSM
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                             71
Homo_sapiens                 IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGG FMLTPGNPKW ERTNLTYRIR NYTPQLSEAE
Mus_musculus                 VAEKLKEMQR FFSLAETGKL DAATMGIMEM PRCGVPDSGD FLLTPGSPKW THTNLTYRII NHTPQLSRAE
Aotus_nancymaae              IVEKLKEMQR FFGLNVTGKP NAETLEMMKQ PRCGVPDSGD FMITPGNPKW EQTNLTYRII NYTPQLSETE
Carlito_syrichta             IVEKLKEMQR FFGLNVTGKP DAETLETMEK PRCGVPDRGD FMLTPGNPKW KHTNLTYRII NYTPQLSEAD
Cebus_imitator               IVEKLKEMQQ FFGLNVTGKP NAETLEMMKQ PRCGVPDSGD FMITPGNPKW EQTNLTYRII NYTPQLSETE
Gorilla_gorilla              IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGG FMLTPGNPKW EHTNLTYRIR NYTPQLSVAE
Lemur_catta                  IVEKLKEMQR FFRLNVTGKP DAETLEVMEK PRCGVPDSGD FAITPGNPKW EHTNLTYRII SYTQQLSEAD
Macaca_mulatta               IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMLTPGNPKW ERTNLTYSIL NYTPQLSETD
Macaca_nemestrina            IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMLTPGNPKW ERTNLTYSIL NYTPQLSETD
Microcebus_murinus           VVEKLKEMQR FFGLNVTGKP DAETLEVMEK PRCGVPDSSS FMITPGSPKW EHTNVTYRII SHTQQLSVAE
Nomascus_leucogenys          IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMITPGNPKW ERTNLTYRIR NYTPQLSKAD
Nycticebus_coucang           IVEKLKEMQR FFGLNVTGKP NAETLEMMEK PRCGVPDTAG FVLTPGNPKW EHINLTYRFI NYTPQLSKTD
Otolemur_garnettii           IVEKLKEMQR FFGLNVTGKP NAETLEMMEK PRCGVPDTAG FMLTPGSPKW EHTNLTYRFI NYTPQLSKTD
Pan_paniscus                 IIEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGG FMLTPGNPKW ERTNLTYRIR NYTPQLSEAE
Pan_troglodytes              IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGG FMLTPGNPKW EHTNLTYRIR NYTPQLSEAE
Papio_anubis                 IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMLTPGNPKW EHTNLTYRIL NYTPQLSETD
Piliocolobus_tephrosceles    IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDTGD FMLTPGNPKW KHTNLTYSIL NYTPQLSQTD
Pongo_abelii                 IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGE FMLTPGNPKW ERTNLTYRIR NYTPQLSEDD
Pongo_pygmaeus               IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGE FMLTPGNPKW ERTNLTYRIR NYTPQLSEDD
Saimiri_boliviensis          IVEKLKEMQR FFGLNVTGKP DAETLEMMKQ PRCGVPDSGD FMITPGNPKW EQTNLTYRFI NYTPQLSVTE
Sapajus_apella               IVEKLKEMQQ FFGLNVTGKP NAETLEMMKQ PRCGVPDSGD FMITPGNPKW EQTNLTYRII NYTPQLSETE
Symphalangus_syndactylus     IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMITPGNPKW ERTNLTYRIR NYTPQLSKTD
Theropithecus_gelada         IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMLTPGNPKW ERTNLTYRIL NYTPQLSETD
Trachypithecus_francoisi     IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDTGD FMLTPGNPKW KHTNLTYSIL NYTPQLSKTD
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Mus_musculus              VKTAIEKAFH VWSVASPLTF TEILQGEADI NIAFVSRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDS
Aotus_nancymaae           VETAIGNAFK VWSNASSLTF TRISQGEANI SIAFFHRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDA
Carlito_syrichta          VDSAIERAFE LWSHASPLRF TRISQGEPDI KIAFVQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Cebus_imitator            VERAIGDAFK VWSDVSPLTF TRISQGEADI NIAFYQKDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Gorilla_gorilla           VERAIKDAFE LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Lemur_catta               VETAIEKAFK VWSDVSPLTF TRISRGEADI KIAFYLRDHG DNSPFDGPNG ILAHAFQPGR GIGGDVHFDA
Macaca_mulatta            VEGAIKKAFE VWSKASPLTF TRISQGQADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Macaca_nemestrina         VEGAIKKAFE VWSKASPLTF TRISQGQADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Microcebus_murinus        VGAAFEKAFK LWSGASPLTF TRISQGEADI KIAFVQRDHG DNSPFDGPNG ILAHAFQPGP GIGGDVHFDA
Nomascus_leucogenys       VERAIEKAFK VWSDASPLTF TRISQGEADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Nycticebus_coucang        VETVIEKAFE VWSKASPLTF TKISQGEADI KIAFVRREHG DNSPFDGPNG ILAHAFQPGR GIGGDVHFDE
Otolemur_garnettii        VETVIEKAFE VWSKASPLTF TKTAQGEADI KIAFVQKDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDE
Pan_paniscus              VERAIKDAFK LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Pan_troglodytes           VERAIKDAFE LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Papio_anubis              VEGAIKKAFE VWSKASPLTF TRISQGQADI NIGFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Piliocolobus_tephrosceles VEGTIKKAFE VWSKVSPLTF TRISQGDADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Pongo_abelii              VKTAIEKAFE VWSKASPLTF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDA
Pongo_pygmaeus            VKTAIEKAFE VWSKASPLTF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDA
Saimiri_boliviensis       VETAIGNAFK IWSDPSPLTF TRISQGEADI NIAFFPRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Sapajus_apella            VETAIGDAFK VWSDVSPLTF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Symphalangus_syndactylus  VERAIEKAFK VWSDASPLTF TRISQGEADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Theropithecus_gelada      VEGAIKKAFE VWSKASPLTF TRISQGQADI NIGFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Trachypithecus_francoisi  IEGAIKKAFE VWSKVSPLTF TRISQGEADI NIGFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
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| | 211 | | | | | | |
|---|---|---|---|---|---|---|---|
| Homo_sapiens | EETWTNTSAN | YNLFLVAAHE | FGHSLGLAHS | SDPGALMYPN | YAFRETSNYS | LPQDDIDGIQ | AIYGLSSNPI |
| Mus_musculus | EETWTQDSKN | YNLFLVAAHE | FGHSLGLSHS | TDPGALMYPN | YAYREPSTYS | LPQDDINGIQ | TIYGPSDNPI |
| Aotus_nancymaae | EETWTSTSKN | YNLFLVAAHE | FGHSLGLSHS | SDPGALMYPN | YAFREPSTYS | LPQDDINGIQ | AIYGPSSNPI |
| Carlito_syrichta | EETWTKTSAN | YNLFLVAAHE | FGHSLGLSHS | SDPGALMYPN | YAFREPSTYL | LPQDDINGIQ | AIYGPSDNPI |
| Cebus_imitator | EETWTNTSEN | YNLFLVAAHE | FGHSLGLSHS | SDPGALMYPN | YAFREPSTYS | LPQDDINGIQ | AIYGPSSNPI |
| Gorilla_gorilla | EETWTNTSAS | YNLFLVAAHE | FGHSLGLAHS | SDPGALMYPN | YAFRETSNYS | LPQDDIDGIQ | AIYGLSSNPI |
| Lemur_catta | EETWTTNANN | YNLFLVAAHE | FGHSLGLAHS | SDPGALMYPN | YAFREPSTYT | LPQDDINGIQ | AIYGPSSNPV |
| Macaca_mulatta | EETWTKTSTN | YNLFLVAAHE | FGHSLGLAHS | SDPGALMYPN | YAFRETSNYS | LPQDDINGIQ | AIYGPSSNPI |
| Macaca_nemestrina | EETWTKNSTN | YNLFLVAAHE | FGHSLGLAHS | SDPGALMYPN | YAFRETSNYS | LPQDDINGIQ | AIYGPSSNPI |
| Microcebus_murinus | EETWTTNFNN | YNLFLVAAHE | FGHSLGLAHS | SDAGALMYPN | YAFSEPSTYT | LPQDDINGIQ | AIYGPSNNPI |
| Nomascus_leucogenys | EETWTKTSTN | YNLFLVAAHE | FGHSLGLAHS | SDPGALMYPN | YAFRETSTYS | LPQDDIDGIQ | AIYGPSSNPI |
| Nycticebus_coucang | EETWTTTAVN | YNLFLVAAHE | FGHSLGLSHS | TDPGALMYPN | YAFNDPSTYS | LPQDDINGIQ | AIYGPSSSPV |
| Otolemur_garnettii | EETWTTTSIN | YNLFLVAAHE | FGHSLGLSHS | SDPGALMYPN | YAFNEPSTYS | LPQDDINGIQ | AIYGPSNSPV |
| Pan_paniscus | EETWTDTSAN | YNLFLVAAHE | FGHSLGLAHS | SDPGALMYPN | YAFRETSNYS | LPQDDIDGIQ | AIYGLSSNPI |
| Pan_troglodytes | EETWTDTSAN | YNLFLVAAHE | FGHSLGLAHS | SDPGALMYPN | YAFRETSNYS | LPQDDIDGIQ | AIYGLSSNPI |
| Papio_anubis | EETWTKDFTN | YNLFLVAAHE | FGHSLGLAHS | SDPGALMYPN | YAFRETSNYS | LPQDDINGIQ | AIYGPSSNPI |
| Piliocolobus_tephrosceles | EETWTTNSTN | YNLFLVAAHE | FGHSLGLAHS | FDPGALMYPN | YAFRETSNYS | LPQDDINGIQ | AIYGPSSNPI |
| Pongo_abelii | EETWTKTSAN | YNLFIVAAHE | FGHSLGLAHS | SDPGALMYPN | YAFTETSNYS | LPQDDIDGIQ | AIYGPSSNPV |
| Pongo_pygmaeus | EETWTKTSAN | YNLFIVAAHE | FGHSLGLAHS | SDPGALMYPN | YAFTETSNYS | LPQDDIDGIQ | AIYGPSSNPV |
| Saimiri_boliviensis | EETWTSTSEN | YNLFLVAAHE | FGHSLGLSHS | SDPGALMYPN | YAFREPSTYS | LPQDDINGIQ | AIYGPSSNPI |
| Sapajus_apella | EETWTNTPEN | YNLFLVAAHE | FGHSLGLSHS | SDPGALMYPN | YAFREPSTYS | LPQDDINGIQ | AIYGPSSNPI |
| Symphalangus_syndactylus | EETWTKTSAN | YNLFLVAAHE | FGHSLGLAHS | SDPGALMYPN | YAFRETSTYS | LPQDDIDGIQ | AIYGPSSNPI |
| Theropithecus_gelada | EETWTKDFTN | YNLFLVAAHE | FGHSLGLAHS | SDPGALMYPN | YAFRETSNYS | LPQDDINGIQ | AIYGPSSNPI |
| Trachypithecus_francoisi | EETWTTNSTN | YNLFLVAAHE | FGHSLGLAHS | FDPGALMYPN | YAFRETSNYS | LPQDDINGIQ | AIYGPSSNPI |

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Homo_sapiens              QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Mus_musculus              QPTGPSTPKA CDPHLRFDAT TTLRGEIYFF KDKYFWRRHP QLRTVDLNFI SLFWPFLPNG LQAAYEDFDR
Aotus_nancymaae           QPTGPSTPRP CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Carlito_syrichta          QPTGPSTPRT CDPRLTFDAI TTLRGEIFFF RDKYFWRRHP QLRSIEFNFI SLFWPALPDS IQAAYEDLDR
Cebus_imitator            QPTGPSTPRP CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Gorilla_gorilla           QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Lemur_catta               QPTGPSTPRS CDPRLTFDAI TTLRGEILFF KDKYFWRRHP QLRSVELNFI SLFWPNLPNG IQAAYEDFDR
Macaca_mulatta            QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Macaca_nemestrina         QPTGPTTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Microcebus_murinus        QPTGPSTPMA CDPRLTFDAI TTLRGEIFFF KDKYFWRRHP QLRSVELNFI SLFWPSLPNG IQAAYEDFDK
Nomascus_leucogenys       QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDSDR
Nycticebus_coucang        QPTGPSTPRT CDPRLTFDAI TTLRGEILFF KDKYFWRKHP QLPTVELNFI SLFWPSLPNG IQAAYEDFDR
Otolemur_garnettii        QPTGPSTPRT CDPRLTFDAI TTLRGEILFF KDKYFWRKHP QLPTAELNFI SLFWPSLPNG IQAAYEDFER
Pan_paniscus              QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Pan_troglodytes           QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Papio_anubis              QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Piliocolobus_tephrosceles QPTGPSTPES CDPRLTFDAI TTLRGEILFF KDEYFWRRHP WLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Pongo_abelii              QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRIEMNFI SLFWPSLPTG MQAAYEDFDR
Pongo_pygmaeus            QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRIEMNFI SLFWPSLPTG MQAAYEDFDR
Saimiri_boliviensis       QPTGPSTPRS CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLRRVEMNFI SLFWPSLPTG IQAAYEDFDR
Sapajus_apella            QPTGPSTPRP CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Symphalangus_syndactylus  QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Theropithecus_gelada      QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Trachypithecus_francoisi  QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
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Homo_sapiens                  DLIFLFKGNQ YWALSGYDIL QGYPKDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Mus_musculus                  DLVFLFKGRQ YWALSGYDLQ QGYPRDISNY GFPRSVQAID AAVSYNGKTY FFINNQCWRY DNQRRSMDPG
Aotus_nancymaae               DLVFLFKGNQ YWALSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Carlito_syrichta              DLVFLFKGNQ YWAMNGYDLQ PGYPRDISNY GFPSNVQAID AAVYFRSKTY FFVNDQFWRY DNERQTMEPG
Cebus_imitator                DLVFLFKGNQ YWALSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQLMEPG
Gorilla_gorilla               DLIFLFKGNQ YWALSGYDIL QGYPKDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Lemur_catta                   DLVFLFKGNQ YWALSGYDIQ QGYPRYISNY GFPSTVQAID AAVSYGSETY FFVNDQFWRY DNQRQAMDPG
Macaca_mulatta                DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Macaca_nemestrina             DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Microcebus_murinus            DLVFLFKGNQ YWAMSGYDIQ QGYPRHISNY GFPSNVQAID AAVSYGRKTY FFVNDQLWRY DNQRQAMDPG
Nomascus_leucogenys           DLIFLFKGNQ YWALSGYDIQ QGYPKSISNY GFPCSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Nycticebus_coucang            DLVFLFKGNQ YWALNGYDIQ EGYPRDISNY GFPSTVQAID AAVSYRRKTY FFVNDQFWRY DNQRQLMEPG
Otolemur_garnettii            DLVFLFKGNQ YWALNGYEIQ QGYPRDISNY GFPSTVQAVD AAVFYRRKTY FFVNDQFWRY DNQRQFMEPG
Pan_paniscus                  DLIFLFKGNQ YWALSGYDIL QGYPKDIANY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Pan_troglodytes               DLIFLFKGNQ YWALSGYDIL QGYPKDIANY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Papio_anubis                  DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Piliocolobus_tephrosceles     DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Pongo_abelii                  DLIFLFKGNQ YWALSGYDIL QGYPKNISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Pongo_pygmaeus                DLIFLFKGNQ YWALSGYDIL QGYPKNISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Saimiri_boliviensis           DLVFLFKGNQ YWALSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYKSKTY FFVNDQFWRY DNQRQFMEPG
Sapajus_apella                DLVFLFKGNQ YWALSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQLMEPG
Symphalangus_syndactylus      DLIFLFKGNQ YWALSGYDIQ QGYPKSISNY GFPCSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Theropithecus_gelada          DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Trachypithecus_francoisi      DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
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Aotus_nancymaae            YPQSISYIFP GIESKVDAVF QQEHFFLFFS GPLYYAFDLS AQRVTRVARG NKWLNCR--
Carlito_syrichta           YPKSTLSIFP GIESKVDAVF QQNYFFFFFS GPRFYAFDLQ AHRVTRVDRS NRWLNCR--
Cebus_imitator             YPQRISDIFP GIERKVDAVF QQEHFFLFFS GPIYYAFDLS AQRVTRVARG NKWLNCR--
Gorilla_gorilla            YPKSISGAFP GIESKVDAVF QQQHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Lemur_catta                YPQSILRTFP GIQSKVDAVF QKDDFFLFFS GPLYYAFNLS TRRVTRIDRS NKWLNCR--
Macaca_mulatta             YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Macaca_nemestrina          YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Microcebus_murinus         YPQSISSTFP GIQSRVDAVF QQDDFFLFFS GPRYYAFNLS TNRVTRLDKS NKWLNCR--
Nomascus_leucogenys        YPKSISGTFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVERG NKWLNCRYG
Nycticebus_coucang         YPKSLSTAFP GIESRVDAVF QRDYVFLFFS GPRYYAFDLN TRRVIRIDRS NIWLNCR--
Otolemur_garnettii         YPKSISTAFP GIESRVDAVF HRDYVFVFFS GPRYYAFDLN TRRVIRIDRS NKWLNCR--
Pan_paniscus               YPKSISGAFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Pan_troglodytes            YPKSISGAFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Papio_anubis               YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Piliocolobus_tephrosceles  YPKSTSGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTTVARA NEWLNCRYS
Pongo_abelii               YPKSISDTFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Pongo_pygmaeus             YPKSISDTFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCR--
Saimiri_boliviensis        YPQSISGIFP GIESKVDAVF QQEHFFLFFS GPIYYAFDLS AQRVTKIARG NKWLNCR--
Sapajus_apella             YPQRISDIFP GIERKVDAVF QQEHFFLFFS GPIYYAFDLS AQRVTRVARG NKWLNCR--
Symphalangus_syndactylus   YPKSISDTFP GIESKVDAVF QQERFFLFFS GPRYYAFDLI AQRVTRVERG NKWLNCRYG
Theropithecus_gelada       YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Trachypithecus_francoisi   YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
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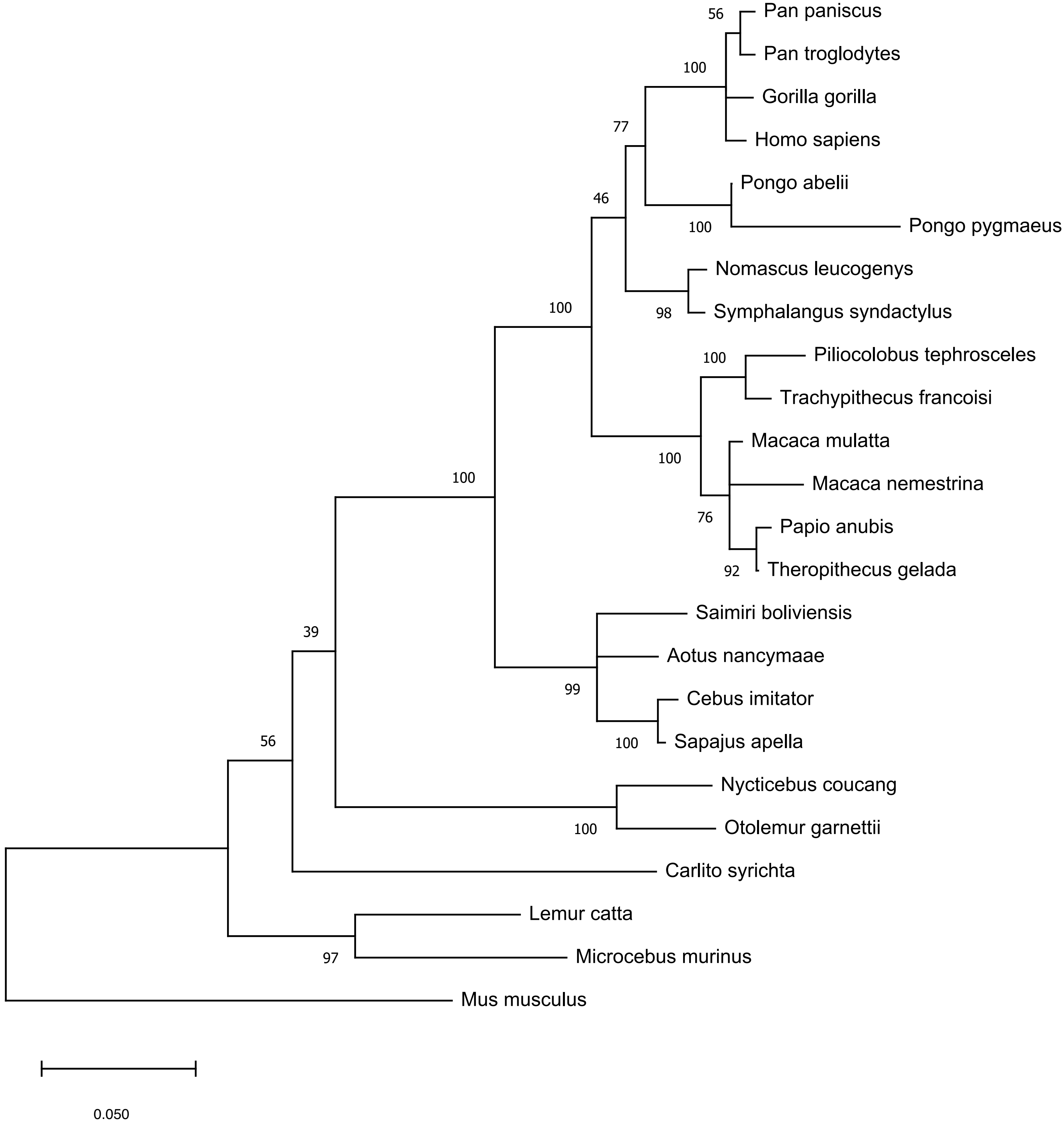

Pan paniscus
Pan troglodytes
Gorilla gorilla
Homo sapiens
Pongo abelii
Pongo pygmaeus
Nomascus leucogenys
Symphalangus syndactylus
Piliocolobus tephrosceles
Trachypithecus francoisi
Macaca mulatta
Macaca nemestrina
Papio anubis
Theropithecus gelada
Saimiri boliviensis
Aotus nancymaae
Cebus imitator
Sapajus apella
Nycticebus coucang
Otolemur garnettii
Carlito syrichta
Lemur catta
Microcebus murinus
Mus musculus
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Mus_musculus               MHSAILATFF LLSWTPCWSL PLPYGDDDDD DLSEEDLVFA EHYLKSYYHP ATLAGILKKS TVTSTVDRLR
Aotus_nancymaae            MHLGVLAAFL FLNWTHCRAL PLPNG-DDED DLSEEDLQFA ERYLKLYYHP TNLAGILKKN SANSMADRLR
Carlito_syrichta           MHPGVLTAFL LLCWTQCQSL PLPNG-EDED DTSEEDLQFA ERYLRSFYHP VNLAGILKKN AASSMVDRLR
Cebus_imitator             MHPGVLAAFL FLSWTHCWAL PLPNG-DDED DLSEEDLQFA ERYLKLYYHP TNLAGILKKN SASSMTDRLR
Gorilla_gorilla            MHPGVLAAFL FLSWTHSRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Lemur_catta                MHPGILVAFL FLSWTHCRSL PLPNG--DDD DLSEEDLQFA ERYLKSYYHP PNLAGILKET SASSMVDRLR
Macaca_mulatta             MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Macaca_nemestrina          MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Microcebus_murinus         -MQGVLVAFL FLSWTHCRSL PLPDG--DDD DLSEEDLQFA ERYLKSYYHP PILAGILKKT SASSMVDRLR
Nomascus_leucogenys        MHPGILAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Nycticebus_coucang         MLPGVLLAFL FLSWTHCRAL PLPND-DDDD DLSEEDLQFA ERYLKSYYYP PNLAGILKKT SASSMIDRLR
Otolemur_garnettii         MLPRVLLAFL FLSWTPCRAL PLPNG--DDD DLSEEDLQFA EHYLKSYYHP LNLAGILKKT SASSMIDRLR
Pan_paniscus               MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTERLR
Pan_troglodytes            MHPGVLAAFL FLSWAHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTERLR
Papio_anubis               MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Piliocolobus_tephrosceles  MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Pongo_abelii               MHPGVLAAFL FLSWTHCRAL PLPSD-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Pongo_pygmaeus             MHPGVLAAFL FLSWTHCRAL PLPSD-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Saimiri_boliviensis        MHPGVLAAFL FLSWTHCRAL PLPNG-DDED DLSEEDLQFA ERYLKLYYHP TNLAGILKKN SASSMTDRLR
Sapajus_apella             MHPGVLAAFL FLSWTHCWAL PLPNG-DDED DLSEEDLQFA EHYLKLYYHP TNLAGILKKN SASSMTDRLR
Symphalangus_syndactylus   MHPGILAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Theropithecus_gelada       MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Trachypithecus_francoisi   MHPVVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
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Homo_sapiens                EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Mus_musculus                EMQSFFGLEV TGKLDDPTLD IMRKPRCGVP DVGEYNVFPR TLKWSQTNLT YRIVNYTPDM SHSEVEKAFR
Aotus_nancymaae             EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Carlito_syrichta            EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIENYTPDM PHSEVEKAFK
Cebus_imitator              EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWPKMNLT YRIVNYTPDM THSEVEKAFK
Gorilla_gorilla             EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Lemur_catta                 EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWTQTNLT YRIVNYTPDM PHSEVEKAFK
Macaca_mulatta              EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Macaca_nemestrina           EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Microcebus_murinus          EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWTQTNLT YRIVNYTPDM THSEVEKAFK
Nomascus_leucogenys         EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Nycticebus_coucang          EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWTKTNLT YRIVNYTPDM THSEVEKAFK
Otolemur_garnettii          EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWTKTNLT YRIVNYTPDM THSEVEKAFK
Pan_paniscus                EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Pan_troglodytes             EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Papio_anubis                EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Piliocolobus_tephrosceles   EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Pongo_abelii                EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Pongo_pygmaeus              EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Saimiri_boliviensis         EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWSRMNLT YRIVNYTPDM THSEVEKAFK
Sapajus_apella              EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWPKMNLT YRIVNYTPDM THSEVEKAFK
Symphalangus_syndactylus    EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Theropithecus_gelada        EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Trachypithecus_francoisi    EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWSKVNLT YRIVNYTPDM THSEVEKAFK
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                              141
Homo_sapiens                  KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Mus_musculus                  KAFKVWSDVT PLNFTRIYDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Aotus_nancymaae               KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Carlito_syrichta              KAFKVWSDVT PLNFTRMHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Cebus_imitator                KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Gorilla_gorilla               KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Lemur_catta                   KAFKVWSDVT PLNFTRLHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Macaca_mulatta                KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Macaca_nemestrina             KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Microcebus_murinus            KAFKVWSDVT PLNFTRLHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNLGGDA HFDDDETWTS
Nomascus_leucogenys           KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Nycticebus_coucang            KAFKVWSDVT PLNFTRLHDG TADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Otolemur_garnettii            KAFKVWADVT PLNFTRLHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pan_paniscus                  KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pan_troglodytes               KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Papio_anubis                  KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Piliocolobus_tephrosceles     KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pongo_abelii                  KAFKVWSDVT PLNFTRLHNG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pongo_pygmaeus                KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Saimiri_boliviensis           KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Sapajus_apella                KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Symphalangus_syndactylus      KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Theropithecus_gelada          KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Trachypithecus_francoisi      KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
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| | 211 | | | | | | |
|---|---|---|---|---|---|---|---|
| Homo_sapiens | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Mus_musculus | SSKGYNLFIV | AAHELGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQFLYGPG | DEDPNPKHPK |
| Aotus_nancymaae | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQFLYGPG | DEDPNPKHPK |
| Carlito_syrichta | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | NHFVLPDDDV | QGIQTLYGPG | DEDPNPKHPK |
| Cebus_imitator | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTSK | SHFMLPDDDV | QGIQFLYGPG | DEDPNPKHPK |
| Gorilla_gorilla | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Lemur_catta | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFVLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Macaca_mulatta | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Macaca_nemestrina | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Microcebus_murinus | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFVLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Nomascus_leucogenys | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Nycticebus_coucang | SSKGYNLFLV | AAHELGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPEDDV | QGIQFLYGPG | DEDPNPKHPK |
| Otolemur_garnettii | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFVLPEDDV | QGIQSLYGPG | DEDPNPKHPK |
| Pan_paniscus | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Pan_troglodytes | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Papio_anubis | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFVLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Piliocolobus_tephrosceles | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Pongo_abelii | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Pongo_pygmaeus | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Saimiri_boliviensis | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTSK | NHFMLPDDDV | QGIQFLYGPG | DEDPNPKHPK |
| Sapajus_apella | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTSK | SHFMLPDDDV | QGIQFLYGPG | DEDPNPKHPK |
| Symphalangus_syndactylus | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Theropithecus_gelada | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFVLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Trachypithecus_francoisi | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |

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Homo_sapiens                 TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Mus_musculus                 TPEKCDPALS LDAITSLRGE TMIFKDRFFW RLHPQQVEAE LFLTKSFWPE LPNHVDAAYE HPSRDLMFIF
Aotus_nancymaae              TPDKCDPSLS LDAITSLRGE TMVFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSRDLIFIF
Carlito_syrichta             TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSRDLIFIF
Cebus_imitator               TPDKCDPSLS LDAITSLRGE TMVFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Gorilla_gorilla              TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSYDLIFVF
Lemur_catta                  TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPAHDLVFVF
Macaca_mulatta               TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Macaca_nemestrina            TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Microcebus_murinus           TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLVFFF
Nomascus_leucogenys          TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Nycticebus_coucang           TPDKCDPSLS LDAITSLRGE TIIFKDRFFW RLHPQQVDAE LFLTKSFWME LPNRIDAAYE HPSHDLVFIF
Otolemur_garnettii           TPDKCDPSLS LDAITNLRGE TIIFKDRFFW RLHPQQVDAE LFLTKSFWLE LPNRIDAAYE HPSHDLVFIF
Pan_paniscus                 TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Pan_troglodytes              TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Papio_anubis                 TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Piliocolobus_tephrosceles    TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Pongo_abelii                 TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Pongo_pygmaeus               TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Saimiri_boliviensis          TPDKCDPSLS LDAITSLRGE TMVFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Sapajus_apella               TPDKCDPSLS LDAITSLRGE TMVFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Symphalangus_syndactylus     TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Theropithecus_gelada         TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Trachypithecus_francoisi     TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
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Homo_sapiens                  RGRKFWALNG YDILEGYPKK ISELGLPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Mus_musculus                  RGRKFWALNG YDILEGYPRK ISDLGFPKEV KRLSAAVHFE NTGKTLFFSE NHVWSYDDVN QTMDKDYPRL
Aotus_nancymaae               RGRKFWALNG YDILEGYPKK ISELGFPKEI KKISAAVHFE DTGRTLFFSG NHVWRYDDTN QIMDKDYPRL
Carlito_syrichta              RGRKFWALNG YDIMEGYPQK ISELGFPKEV KKISAAVHFE DTGKTLFFSG NQVWSYDDTN HVMDKDYPRF
Cebus_imitator                RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGRTLFFSG NQVWRYDDTN QIMDKDYPRL
Gorilla_gorilla               RGRKFWALNG YDILEGYPKK ISELGLPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Lemur_catta                   RGRKFWALNG YDIMEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLFFSG NQVWRYDDTN HIMDTDYPRL
Macaca_mulatta                RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Macaca_nemestrina             RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Microcebus_murinus            RGRKFWALNG YDIMEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLFFSG NQVWRYDDTN QIMDKDYPRL
Nomascus_leucogenys           RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Nycticebus_coucang            RGRKFWALNG YDIMEGYPKK ISELGFPKEV KKISAAVHFE DRGKTLFFSG NQVWSYDDTN HIMDKDYPRL
Otolemur_garnettii            RGRKFWALNG YDIMEGYPKK ISELGFPKEV KKISAAVHFE DRGKTLFFSG NQVWSYDDTN HIMDKDYPRL
Pan_paniscus                  RGRKFWALNG YDILEGYPKK ISELGLPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Pan_troglodytes               RGRKFWALNG YDILEGYPKK ISELGLPKEV KKISATVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Papio_anubis                  RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Piliocolobus_tephrosceles     RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Pongo_abelii                  RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Pongo_pygmaeus                RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Saimiri_boliviensis           RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLFFSG NQVWRYDDTN QIMDKDYPRL
Sapajus_apella                RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGRTLFFSG NQVWRYDDTN QIMDKDYPRL
Symphalangus_syndactylus      RGRKFWALNG YDILEGYPQK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Theropithecus_gelada          RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Trachypithecus_francoisi      RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
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                                 421
Homo_sapiens                      IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Mus_musculus                      IEEEFPGIGN KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPTNSIL
Aotus_nancymaae                   IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSKRI VRVMPANSIL
Carlito_syrichta                  IEEVFPGIGD KVDAVYEKNG YIYFFNGPIQ FEF------- ---------- ---SVWSKRI VRVMTANSLL
Cebus_imitator                    IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSKRI VRVMPANSIL
Gorilla_gorilla                   IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Lemur_catta                       IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPTNSLL
Macaca_mulatta                    IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Macaca_nemestrina                 IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Microcebus_murinus                IEEDFPGIGD KVDAVYEKNG YIYFFSGPIQ FEY------- ---------- ---SIWSNRI VRVMPTNSLL
Nomascus_leucogenys               IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Nycticebus_coucang                IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSDRI VRVMPTNALL
Otolemur_garnettii                IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPTNALL
Pan_paniscus                      IEEEFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Pan_troglodytes                   IEEEFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Papio_anubis                      IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Piliocolobus_tephrosceles         IEEDFPGIGD KVDAVYEKNG YIYFFNGPTQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Pongo_abelii                      IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Pongo_pygmaeus                    IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Saimiri_boliviensis               IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSKRI VRVMPANSIL
Sapajus_apella                    IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSKRI VRVMPANSIL
Symphalangus_syndactylus          IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Theropithecus_gelada              IEEDFPGIGD KVDAVYEKNE SHFVVQAGVQ WHNLSSLQPP PPGFKRFSCL SLRSSWNYRL YLFFQRAHTV
Trachypithecus_francoisi          IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
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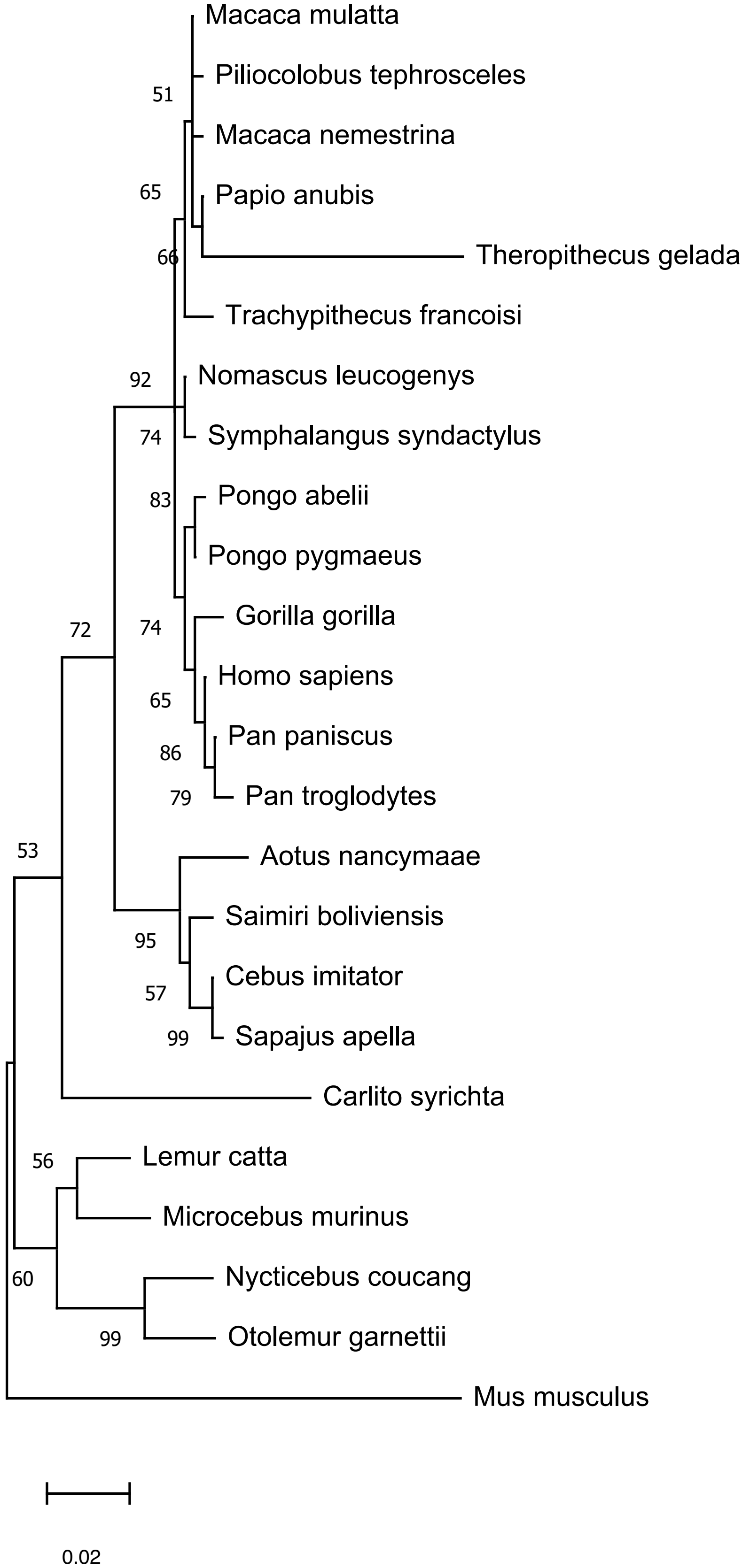
| | 491 |
|---|---|
| Homo_sapiens | WC |
| Mus_musculus | WC |
| Aotus_nancymaae | WC |
| Carlito_syrichta | WC |
| Cebus_imitator | WC |
| Gorilla_gorilla | WC |
| Lemur_catta | WC |
| Macaca_mulatta | WC |
| Macaca_nemestrina | LC |
| Microcebus_murinus | WC |
| Nomascus_leucogenys | WC |
| Nycticebus_coucang | WC |
| Otolemur_garnettii | WC |
| Pan_paniscus | WC |
| Pan_troglodytes | WC |
| Papio_anubis | WC |
| Piliocolobus_tephrosceles | WC |
| Pongo_abelii | WC |
| Pongo_pygmaeus | WC |
| Saimiri_boliviensis | WC |
| Sapajus_apella | WC |
| Symphalangus_syndactylus | WC |
| Theropithecus_gelada | -- |
| Trachypithecus_francoisi | WC |


Macaca mulatta
Piliocolobus tephrosceles
Macaca nemestrina
Papio anubis
Theropithecus gelada
Trachypithecus francoisi
Nomascus leucogenys
Symphalangus syndactylus
Pongo abelii
Pongo pygmaeus
Gorilla gorilla
Homo sapiens
Pan paniscus
Pan troglodytes
Aotus nancymaae
Saimiri boliviensis
Cebus imitator
Sapajus apella
Carlito syrichta
Lemur catta
Microcebus murinus
Nycticebus coucang
Otolemur garnettii
Mus musculus
51
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92
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65
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A glimpse on the discussions…

# A Bioinformatic Study on the Molecular Evolution of Collagenases in Primates

*A project report submitted to the* ***University of Calicut*** *in partial fulfilment of the requirement for the award of the Degree*

## BACHELOR OF SCIENCE IN ZOOLOGY

BY


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# CERTIFICATE

This is to certify that the project work entitled **'A Bioinformatic Study on the Molecular Evolution of Collagenases in Primates'** is an authentic record of research work carried out by **Chandana Janardhanan, Lakshmi AP, Niharika, Salvador VS, Abhinav Krishna PV, Aysha Nedha Sakir, Mithralmajan PT, Anjima NC** and **Grace Maria Paulson** as part of BSc syllabus during the year **2023-2024** and the results of this work has not been presented for the award of any other degree/ diploma in any university.

### Certified bona fide by

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# DECLARATION

We, the following students do hereby declare that this project report entitled **'A Bioinformatic Study on the Molecular Evolution of Collagenases in Primates'** is a genuine record of the project work done by us under the guidance of Dr. Leyon Varghese, Assistant Professor, Department of Zoology, Christ College (Autonomous), Irinjalakuda and that this report has not been submitted to any University/Institution for the award of any Degree or Diploma. We further declare that the results presented in this work and considerations made therein, contribute in general to the advancement of knowledge in science and is devoid of any plagiarism.

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## INTRODUCTION

The first true primates evolved around 55 million years ago or a bit earlier, near the beginning of the Eocene Epoch. Their fossils have been found in North America, Europe, and Asia. They looked different from the present day primates. Changes in gene regulation and differences in mRNA expression levels across primates have often been documented, however, it is not yet known to what extent measurements of divergence in mRNA levels reflect divergence in protein expression levels, which are probably more important in determining phenotypic differences. Collagenases, a subgroup of Matrix matalloproteases (MMPs) are a large family of zinc-dependent endopeptidases with a great affinity for several components of the extracellular matrix. The collagenases include MMP-1 (interstitial collagenase/collagenase-1), MMP-8 (neutrophil collagenase/collagenase-2), and MMP-13 (collagenase-3). These MMPs attack triple helical regions of interstitial collagen types I, II, and III at a specific single site after the Gly residue of the partial sequences Gly-(Ile or Leu)-(Ala or Leu), located about three-fourths of the distance from the N-terminus. This cleavage generates fragments approximately three-fourths and one-fourth of the size of the collagen molecules. They are distinct from a closely related gelatinases (MMP2 and 9) that are characterized by the presence of the additional fibronectin domain located inside the catalytic domain.

A phylogenetic tree  or evolutionary tree is a graphical representation which shows the evolutionary history between a set of species or taxa during a specific time. In other words, it is a branching diagram or a tree showing the evolutionary relationships among various biological species or other entities based upon similarities and differences in their physical or genetic characteristics. In evolutionary biology, all life on Earth is theoretically part of a single phylogenetic tree, indicating common ancestry. Phylogenetics is indeed the study of this phylogenetic tree. The main challenge is to find a phylogenetic tree representing optimal evolutionary ancestry between a set of species or taxa. The  first step in the phylogenetic tree construction (using bioinformatics tool) with a new sequence would be to use BLAST. This nifty yet powerful resource matches your sequence to the millions of sequences stored in genomic and nucleotide databases. The tool comes up with the sequences most similar to the query submitted.

It also gives insights as to the possible identity of those sequences. The results include homologues across species and in similar tissues or organisms. A sequence alignment is a way of arranging the sequences of DNA, RNA, or protein to identify regions of similarity that may be a consequence of functional, structural, or evolutionary relationships between the sequences. If two sequences in an alignment, they share a common ancestor and mismatches can be interpreted as point mutations and gaps as indels (that is, insertion or deletion mutations) introduced in one or both lineages in the time since they diverged from one another. In sequence alignments of proteins, the degree of similarity between amino acids occupying a particular position in the sequence can be interpreted as a rough measure of how conserved a particular region or sequence motif is among lineages.

Phylogenetics and sequence alignment are closely related fields due to the shared necessity of evaluating sequence relatedness. The field of phylogenetics makes extensive use of sequence alignments in the construction and interpretation of phylogenetic trees, which are used to classify the evolutionary relationships between homologous genes represented in the genomes of divergent species. The degree to which sequences in a query set differ is qualitatively related to the sequences evolutionary distance from one another. Roughly, high sequence identity suggests that the sequences in question have a comparatively young most recent common ancestor, while low identity suggests that the divergence is more ancient. This approximation, which reflects the "molecular clock" hypothesis that a roughly constant rate of evolutionary change can be used to extrapolate the elapsed time since two genes first diverged , assumes that the effects of mutation and selection are constant across sequence lineages.

## REVIEW OF LITERATURE

Primates are unique among placental mammals. Two extreme type of placentation are present in this single order. Strepsirrhines have non-invasive epitheliochorial placentation and Haplorhines have highly invasive haemochorial placentation. Strepsirrhines include Lemurs and Lorisiforms and Haplorhines include tarsiers and higher primates. Resemblance in placenta type provide the first evidence that tarsiers are linked to higher primates and distinct from lemurs and lorisiforms. Tree-shrews have endotheliochorial placentation and differ from both primate subgroups. Endotheliochorial placentation is primitive and epitheliochorial placentation is unlikely to be primitive.The recent availability of comprehensive molecular phylogenies for placental mammals has provided an independent framework to determine the most parsimonious interpretation of the evolution of placenta types (Robert Martin, 2008). In an earlier elaborate study, speciation between primates and rodents was estimated by looking at the protein coding genes of mitochondrial genomes from 31 mammals (A.D Yoder 2000). Based on paleontological data, three calibration points were used: one at 20–25 MYA for the hominoid/cercopithecoid divergence, one at 53–57 MYA for the cetacean/artiodactyl divergence, and the third at 110–130 MYA for the metatherian/eutherian divergence. Nulceotide and the amino acid sequence were looked at and results produced that were not mutually exclusive.

Even with decades of data and methods, we still can't agree on the exact evolutionary tree of higher primates (apes and humans). The most likely scenario has humans closest to chimps, but other possibilities exist. Despite numerous theories, 20 key reasons cause this uncertainty. New methods using DNA offer hope for more definitive answers. (Holmquist et al 1988). Primate phylogeny forms a solid framework for a novel depiction of diverse patterns of genome evolution among primate lineages. They are essential for future comparative genomic investigation of adaptation and selection in humans and across primates. Studies on the evolution of catarrhine primates were done using molecular, fossil and bio geographical data. It was found that the common ancestor of Old World Monkeys originated in Africa and some monkeys later moved to Asia around 10 million years ago. The study further suggested that the ancestor of the

living hominids left Africa about 20 mya and the common ancestor of the living African apes returned to Africa from Eurasia around 10 mya (Caro-Beth Stewart, Todd R Disotell 1998).

In the deep study of evolutionary roots of strepsirrhine primate labyrinthine morphology, geometric morphometric analysis showed that the labyrinthine morphology of extant strepsirrhines contains a mixed locomotor, allometric and phylogenetic signal. Discriminant analysis at the family level confirmed that labyrinthine shape is a good taxonomic marker. The results support the hypothesis that evolutionary change in labyrinthine morphology is adequately described with a random walk model, i.e. random phenotypic dispersal in morphospace (Lebrun et al, 2010). An overview of the taxonomy of New World primates based on morphology to the great number of studies based on molecular data aiming for the elucidation of the phylogeny of New World monkeys. The traditional classification of the infraorder Platyrrhini divided these primates into Cebidae and the Callitrichidae, with Callimico being allocated to either the former (Simons, 1972, Simpson, 1945) or the latter family. Hill (1957) and Hershkovitz, 1972, Hershkovitz, 1977 proposed a third family – Callimiconidae – to accommodate Callimico, because it shares characteristics that define both cebids and callitrichids. According to Hershkovitz (1977), then all New World primates should be included in one of three families – the Callitrichidae which comprised the marmosets, tamarins (Saguinus) and lion tamarins (Leontopithecus), the monotypic Callimiconidae (Callimico) and the Cebidae (Schneider et al, 2015).

In a study on molecular phylogeny and evolution of primate mitochondrial DNA, researchers determined nucleotide sequences of homologous 0.9-kb fragments of mitochondrial DNAs (mtDNAs) derived from four species of old-world monkeys, one species of new-world monkeys, and two species of prosimians. With these nucleotide sequences and homologous sequences for five species of hominoids, they constructed a phylogenetic tree for the four groups of primates. The phylogeny obtained is generally consistent with evolutionary trees constructed in previous studies. The results also suggest that the rate of nucleotide substitution for mtDNAs in hominines (human, chimpanzee, and gorilla) have slowed down compared with that for old-world monkeys (Hayasaka, 1988). Mitochondrial genomes have been used to study the

phylogenetic relationship of primates in detail. Using 454 sequencing, the study adds 32 new complete mitochondrial genomes and introduces 20 previously unrepresented genera in the primate tree. The study focuses on the New world monkeys and suborder Strepsirrhini. (Knut Finstermeier, et al 2013). The evolutionary relationships of the number of species within the genus Lepilemur were analysed with the help of a comparative cytogenetic and molecular study. The study involved the complete sequencing of the mitochondrial cytochrome b gene from 68 individuals and the results were compared to those obtained from cytogenetic studies derived from 99 specimens. The results support the classification of the eight major supportive lemur taxa as independent species. (Nicole Andriaholinirina, et al. 2006)

The relationship between the prion protiens and new world primate phylogeny have been studied. The PrP C prion protein contains 250 amino acids with some variation among species and is expressed in several cell types. Variations in the prion protein gene were observed among 16 genera of New World primates (Platyrrhini), and resulted in amino acid substitutions when compared with the human sequence. Schneider et al, 2004)

Beta-globin gene cluster of primates were analyzed to understand their evolutionary history. The rate of accumulation of mutations have also been seen to vary by a factor of 7 among different primate lineages. The study groups superfamilies Lemuroidea and Lorisoidea into suborder Strepsirhini and Tarsius and Anthropoidea into suborder Haplorhini. Evolution rates have been suggested to have slowed down over the past 25 million years of hominoid descent and has found to have happened in correlation with lengthened lifespans (Koop, BF et al 1989).

Using the SINE's methods for the analysis of mobile element based of old world monkeys. It helps to known ancestral staples. Makes them to useful genetic studies for phylogenetic studies. Alu is an helping part of it, in this methods found 285 new Alu Insertions from sixteen old world monkeys. Old world monkeys are  represent on the most diverse and largest primate families. And have  respect classification. The phylogenetic researchers are classified and grouped the old world monkeys into different classes and divisions. Mainly the subfamily  cerocopithecidae  are the most studied group.. SINEs ( short interspersed element are

used  as the genetic markers this  will helps to analysis several levels of phylogenetic analysis. Using both Compcompuational and PCR methods (Xing a et al, 2005).

New world monkeys represent monophyletic group. The phylogenetic relationships among new world monkeys have been extensively investigated using nucleotide sequence from different genome.In these studies still there are some unresolved issues.There are three monophyletic new world monkey families Atelidae, Cebidae and Pitheciidae. As a result Maximum parsimony analysis support the three proposed platyrrhine families. In the maximum parsimony tree, the two most closely related families are Atelidae and Cebidae.Phylogenetic relationships were reconstructed by maximum parsimony, maximum likelihood, and Bayesian approaches (JuanC Opazo et al, 2006). Anthropoid primates from the neotropics are members of parvorder Platyrrhini. The platyrrhines are also called New World monkeys. There are more than 125 species of extant New World monkeys  found in approximately 15 genera. The phylogenetic relationships of these neotropical primates have been extensively studied from a molecular perspective (Derek wildman et al, 2009).

Phylogenetic trees are certainly useful for comparative studies, providing a useful framework for comparative biologists. Species evolution is not statistically independent. The fact that close relatives inherit characteristics from their common ancestor has always complicated the analysis of cross- species data. The methods in turn developed to resolve such issues, all requires resolved phylogeny. In one of the earlier studies, primates phylogeny was estimated of all 203 species of primates. Application of parsimony algorithm and bootstrapping resulted in the composite tree with 160 nodes (Purvis, Andy 1995).

In a project conducted under the support from National Cancer Institute and National Institute of Health, researchers constructed a robust phylogenetic tree of primates. The tree was constructed from the data collected of genomic sequences from 186 primates. Also outgroup species from Dermoptera, Scandentia and Lagomorpha was included. This phylogenetic representation done carefully was a notable illumination showing the pathway of primates evolution (Perelman et.al 2011).

Studies also estimated the molecular divergence dates of major primates in the context of molecular clock studies. Such studies also aid in understanding the lineage. Utilizing the genomic data, molecular divergence dates were able to be studied since alignments can be arranged and sites can be analysed for this study. Much before the molecular clock, paleontology used to provide only a mere timeframe of species evolution (Steiper et.al. 2006).

Inferring molecular phylogeny for evolutionary studies are done in non- primates as well. The molecular phylogeny of malarial parasites was recovered from mitochondrial cytochrome b gene sequences. Parsimony as well as maximum- likelihood analysis produced similar phylogenetic trees in this case. The conclusions were supported by hypothesis testing (Perkins et.al 2002). Inferring species super matrix has helped in studying macroevolutionary dynamics and even historical biogeography. The results obtained highlighted both the power as well as limitations of inferring the molecular phylogeny data to different species concepts (Springer et.al. 2012).

Over the past 60 million years, a million copies of Alu DNA have appeared in the genomes of primates. This is still an ongoing process. DNA alu repeats in the genomes of primates such as human, chimpanzee, gorilla, orangutan, baboon, rhesus, and macaque. New Alu elements arise in unique and irreversible events and appear to prevent precise excision and loss. The same insertions cannot occur independently in two species. Once the insert is genetically fixed, the DNA elements persist in all descendant lineages. Different from point mutation, the distribution of individual alu corresponds to a phylogeny only (H. Hamdi, 1999).

To resolve the debate in strepsirrhine phylogeny, 61 loci containing interspersed elements were characterized and the absence and presence of orthologous loci in the strepsirrhine panel was determined. According to these findings, it is concluded that strepsirrhines originated in Africa, and that Madagascar and Asia were colonized by immigration events (C. Roos, 2004). To investigate the phylogenetic relationships among species of New World monkeys, 1.3 kb of DNA was collected for 2 introns of the glucose-6-phosphate dehydrogenase locus encoded on the x chromosome of 24 species of New World monkeys (M. Von. Dornum, 1999).

Two molecular based approaches are used to date the initial divergence of the platyrrhine clade, a relaxed clock model using fossil record and genome datasets, and Bayesian inferences from generation time and body size to substitution rate. Fossil constraints, topology, and substitution rate are an important part of our divergence time estimates. making an impact. Bayesian estimates using conservative and realistic fossil constraints suggest that the LCA of extant platyrrhines is 29 Ma, with a 95% confidence interval for Nodine of 27–31 Ma (SI Perez, 2013). The sequences of nuclear protein-coding gene LCAT were used to study the relationship between 19 extant rodents. The study agrees with several previous molecular and morphological studies, both concerning branching orders inside Muroidea and the bush-like radiation of rodent suprafamilial taxa. This indicates that this nuclear gene is a fitting candidate for tackling questions about rodents relationships.

The data from primates were used to reveal that the molecular clock in CpG and non-CpG sites have different nature, projecting differences in their molecular origin. Through the process, it was observed that molecular clocks are heterogeneous even within a genome. During phylogenetic analysis and while concluding divergence times using molecular data, one should be mindful that different regions of genome follow different molecular clocks. In this study, our efforts are directed towards studying the pathway of certain collagenases in the course of evolution. Even though some studies have been done using DNA sequences and that too in different context, in our study we focusses primarily on amino acid sequences. This is not a well researched area. Though this study we aim on providing a new work in the area of comparative biology. The results of the work may be useful in the future providing insights into how may be the few crucial changes in amino acids may have resulted into a complete new lineage.

## SIGNIFICANCE OF THE STUDY

The study of molecular evolution in primates through the comparison of amino acid sequences using bioinformatics tools represents a novel and underexplored area of research. To date, there has been a notable scarcity of studies employing bioinformatics techniques to investigate the evolutionary patterns of primates, particularly in relation to proteins such as MMP1, MMP8 and MMP13 collagenases. The selection of these collagenases for our study is particularly significant due to their split genes nature. By conducting a comparative analysis of the evolutionary trees derived from the collagenases with established standard trees, we aimed to shed light on the distinctive evolutionary trajectories of these proteins in primates. The insights obtained from this comparative study have the potential to deepen our understanding of the molecular evolution of primates and elucidate the factors driving the evolution of collagenases in this taxonomic group.

**OBJECTIVES**

1. Retrieval of relevant data (Gene/mRNA/protein sequence of collagenases of primates) from relevant reliable resources such as NIH or SIB.
2. Align the retrieved sequences using bioinformatics software to ensure they are in the correct reading frame and homologous positions are appropriately aligned.
3. Construction of the phylogenetic trees based on the Gene/mRNA/protein sequence of collagenases in primates.

## METHODOLOGY

The three human collagenases used in the study are MMP1, MMP8 and MMP13. The FASTA sequence and other details of collagenases are as below.

```
>NP_002412.1 interstitial collagenase isoform 1 MMP1 UniProt_P03956 [Homo sapiens]
MHSFPPLLLLLFWGVVSHSFPATLETQEQDVDLVQKYLEKYYNLKNDGRQVEKRRNSGPVVEKLKQMQEF
FGLKVTGKPDAETLKVMKQPRCGVPDVAQFVLTEGNPRWEQTHLTYRIENYTPDLPRADVDHAIEKAFQL
WSNVTPLTFTKVSEGQADIMISFVRGDHRDNSPFDGPGGNLAHAFQPGPGIGGDAHFDEDERWTNNFREY
NLHRVAAHELGHSLGLSHSTDIGALMYPSYTFSGDVQLAQDDIDGIQAIYGRSQNPVQPIGPQTPKACDS
KLTFDAITTIRGEVMFFKDRFYMRTNPFYPEVELNFISVFWPQLPNGLEAAYEFADRDEVRFFKGNKYWA
VQGQNVLHGYPKDIYSSFGFPRTVKHIDAALSEENTGKTYFFVANKYWRYDEYKRSMDPGYPKMIAHDFP
GIGHKVDAVFMKDGFFYFFHGTRQYKFDPKTKRILTLQKANSWFNCRKN

>NP_002415.1 neutrophil collagenase isoform 1 MMP8 UniProt_P22894 [Homo sapiens]
MFSLKTLPFLLLLHVQISKAFPVSSKEKNTKTVQDYLEKFYQLPSNQYQSTRKNGTNVIVEKLKEMQRFF
GLNVTGKPNEETLDMMKKPRCGVPDSGGFMLTPGNPKWERTNLTYRIRNYTPQLSEAEVERAIKDAFELW
SVASPLIFTRISQGEADINIAFYQRDHGDNSPFDGPNGILAHAFQPGQGIGGDAHFDAEETWTNTSANYN
LFLVAAHEFGHSLGLAHSSDPGALMYPNYAFRETSNYSLPQDDIDGIQAIYGLSSNPIQPTGPSTPKPCD
PSLTFDAITTLRGEILFFKDRYFWRRHPQLQRVEMNFISLFWPSLPTGIQAAYEDFDRDLIFLFKGNQYW
ALSGYDILQGYPKDISNYGFPSSVQAIDAAVFYRSKTYFFVNDQFWRYDNQRQFMEPGYPKSISGAFPGI
ESKVDAVFQQEHFFHVFSGPRYYAFDLIAQRVTRVARGNKWLNCRYG

>NP_002418.1 collagenase 3 MMP13 UniProt_P45452 [Homo sapiens]
MHPGVLAAFLFLSWTHCRALPLPSGGDEDDLSEEDLQFAERYLRSYYHPTNLAGILKENAASSMTERLRE
MQSFFGLEVTGKLDDNTLDVMKKPRCGVPDVGEYNVFPRTLKWSKMNLTYRIVNYTPDMTHSEVEKAFKK
AFKVWSDVTPLNFTRLHDGIADIMISFGIKEHGDFYPFDGPSGLLAHAFPPGPNYGGDAHFDDDETWTSS
SKGYNLFLVAAHEFGHSLGLDHSKDPGALMFPIYTYTGKSHFMLPDDDVQGIQSLYGPGDEDPNPKHPKT
PDKCDPSLSLDAITSLRGETMIFKDRFFWRLHPQQVDAELFLTKSFWPELPNRIDAAYEHPSHDLIFIFR
GRKFWALNGYDILEGYPKKISELGLPKEVKKISAAVHFEDTGKTLLFSGNQVWRYDDTNHIMDKDYPRLI
EEDFPGIGDKVDAVYEKNGYIYFFNGPIQFEYSIWSNRIVRVMPANSILWC
```

The study on phylogenetic relationships in primates was conducted using this amino acid sequences to do the BLAST (Basic Local Alignment Search Tool) analysis in the NCBI Genebank database. The most suitable amino acid sequences for each primate species were then carefully selected from sequences delivered by the server. An out group was chosen which in our study was the Mus musculus of the order Rodentia.

The selected sequences were then compared with that of the out group and a phylogenetic tree was constructed based on the degree of divergence. The software used for constructing phylogenetic tree was  Molecular Evolutionary Genetics Analysis (MEGA).

## RESULTS AND DISCUSSIONS

The research article titled "A Molecular Phylogeny of Living Primates" published in 2011, established a robust and widely accepted framework for understanding primate evolution. This phylogenetic tree served as a standard reference for our study, allowing us to compare our data and draw conclusions. According to this article Order Primata is subdivided into two major Suborder Haplorrhini and Strepsirrhini. The remaining primate phylogeny is classified as follows.

**Suborder Haplorrhini** further divides into Infraorders, namely Simiiformes and Tarsiiformes. Tarsiiforme include only one Family (Tarsiidae) with only two extant species. Simiiformes is subdivided into Parvorders Catarrhini (Old world) and Platyrrhini (New world).

Parvorder Catarrhini in turn consist of the Superfamilies Cercopithecoidea and Hominoidea. Cercopithecoidea has only one extant Family *viz*. Cercopithecidae but the organisms of Superfamily Hominoidea is further divided into two Families, *viz*, Hylobatidae and Hominidae. Family Cercopithecidae has two Subfamilies such as Cercopithecinae and Colobinae. Family Hylobatidae include all Gibbon Genus and there is no further subgrouping. Hominidae on the other hand has two Subfamilies *viz.* Homininae and Ponginae. Subfamily Ponginae include all species of Orangutang and all o there Greater Apes and Humans are included in Homininae. Subfamily Cercopithecinae is subdivided into two Tribes namely, Papionini and Cercopithecini whereas Colobinae is subdivided into two Tribes namely Presbytini and Colobini.

Parvorders Platyrrhini on the other hand is divided directly into three Families such as Cebidae, Atelidae and Pitheciidae. Family Cebidae has four Subfamilies namely, Callitrichinae, Aotinae, Cebinae and Saimirinae. Fly. Atelidae has two Subfamilies (Atelinae & Alouattinae) so also Fly. Pitheciidae (Callicebinae & Pitheciinae).

**Suborder Strepsirrhini** is divided into the Infraorders Lemuriformes, Chiromyiformes and Lorisiformes. Unlike Haplorrhini, there is no observed grouping of these Infraorders into Parvorders or Superfamilies. Instead, they are grouped into Families such as Lepilemuride,

Cheirogaleidae, Indriidae, Lemuridae, Daubentoniidae, Lorisidae and Galagidae. Further subdivision within Lorisidae includes the subfamilies Lorisinae and Perodicticinae.

**MMP-1**

The phylogenetic tree for the MMP1 gene in primates was meticulously constructed, employing an analysis of amino acid sequences from various primate species. To enhance our phylogenetic analysis, *Mus musculus* was strategically employed as the outgroup, providing a reference point for the evolutionary relationships within the MMP1 collagenase gene among primates. Our investigation also utilized a well established standard phylogenetic tree for primates, derived from genomic sequences across diverse species, serving as a foundational reference for elucidating the evolutionary dynamics of collagenase genes within our study group (Reference). The results obtained regarding the evolutionary pathway of the MMP1 gene include the following observations:

- *Carlito syrichta*: Our findings indicate that MMP1 gene of *Carlito syrichta,* a tarsier species primarily descended with minimal changes from the common ancestor of all primates indicating an ancient ancestry. Although this tree suggests such an ancient ancestry and early divergence of *Carlito syrichta* from the early primate stock, a comparison with the established tree reveals that tarsiers diverged from a common stock of strepsirrhini - more primitive primate. It is therefore inferred that the MMP1 gene remained with minimum changes in the tarsiers as compared to strepsirrhini primates.
- *Hominidae:* In our tree constructed using MMP1 the common ancestor of *Pan* and *Homo*, along with the common ancestor of *Gorilla* and *Pongo,* collectively share a common ancestor. Gibbons, including *Nomascus* and *Symphalangus,* share a common ancestor that along with the common ancestor of *Hominidae* were descended from a common stock of interbreeding ape like animal. Upon analysing the standard phylogenetic tree, a similar pattern emerges, with *Homo* and *Pan* sharing a common ancestor. This common ancestor was also ancestral to present day *Gorilla,* from which the *Pongo* ancestry might have diverged. However, the discrepancy in our results suggestive of *Gorilla* sharing a recent

common ancestor with *Pongo,* but not with *Homo* or *Pan*. This suggests a simultaneous origin for *Gorilla* and *Pongo*, contrary to the standard tree's assertion of *Gorilla*'s more recent evolution compared to *Pongo*. Further analysis of the amino acid sequences are required to see if the *Homo-Pan* group has any common advantage with the kind of changes on the MMP1 protein over the *Gorilla-Pongo* group.

- Old World Monkeys: Our results indicate that, three groups *viz. Macaca*, *Papio* and *Theropithecus* are equally distant from a common ancestor, while *Colobus* and *Trachypithecus* share another common ancestor. The standard phylogenetic tree confirms this, revealing a common ancestor for *Colobus* and *Trachypithecus,* along with the ancestor of *Macaca, Papio* and *Theropithecus.* But with *Macaca, Papio* and *Theropithecus,* our results differ from the standard tree. While standard tree implies that *Papio* and *Theropithecus* had a common ancestor after the common ancestry shared with *Macaca,* our tree do not mention between an ancestor common to both *Papio* and *Theropithecus.* Though the changes are minimal, it wold be interesting to look for the their sequences for further analysis.

- New World Monkeys: Our findings in New World Monkeys suggest that *Saimiri* and *Cebus* share a most recent common ancestor, while *Aotus* share a common ancestor with this lineage. This is consistent with both our phylogenetic tree and the standards phylogenetic tree. Furthermore, *Nycticebus* and *Otolemur* share a common ancestor, and *Lemur* and *Microcebus* also share a common ancestor. The common ancestors of these pairs collectively had a single common ancestor, aligning with observations on the standard phylogenetic tree.

**MMP-8**

- *Hominidae*: In the phylogenetic tree derived from MMP8 sequence data, it was observed that the common ancestor of Homo and Gorilla shares ancestry with the common ancestor of Pan. This collective ancestry is further linked to the common ancestor of Hominidae, which is shared with Gibbons. In contrast to the standard phylogenetic tree, where Pan and Homo share an ancestor ancestral to present-day Gorilla, our results suggest the potential existence of an alternative evolutionary pathway for these three species. A comprehensive investigation is recommended to explore the implications of this alternative pathway further.

- Loris: Our findings indicate that the Loris shares a common ancestor with Hominidae, Tarsier, Gibbons, New World, and Old World monkeys, all of which originate from the Strepsirrhini primates. Similarly, Lemurs are shown to arise from Haplorrhini primates. Discrepancies with the standard phylogenetic tree, which suggests a more recent common ancestry for Lemurs and Loris, necessitate further analysis to validate the proposed ancestral pattern among the descendants of these two major groups of early primates.

- New World Monkeys: Upon examining the lineage of New World monkeys, it is observed that recent descendants Aotus and Saimiri share a common ancestor, which is further linked to the common ancestor of Cebus and Sapajus. This lineage can be traced back to early Strepsirrhini primates. Although minor differences are noted compared to the standard phylogenetic tree, where an ancestor common to Saimiri and Cebus precedes the common ancestry with Aotus, further analysis is warranted to explore these nuances.

- Old World Monkeys: Our analysis reveals that Papio and Theropithecus share a common ancestor, which is connected to the common ancestor of Macaca. This ancestral lineage can be traced back to an ancestor shared with the common ancestor of Piliocolobus and Trachypithecus. The observed pattern aligns with the standard phylogenetic tree in the lineage of Old World monkeys.

**MMP-13**

- *Hominidae*: When we comparing the phylogenetic tree made by us on the basis of MMP13 and the standard one, the Nomascus leucogenys & Symphalongus syndactylus (Hylobatidae) share a recent common ancestor and they together share common ancestor with old world monkeys in MMP13. But, when we comparing this with the standard one we can observe that the Hylobatidae sharing common ancestor with Hominidae.

- New World Monkeys: Our findings in new world monkeys by comparing the Standard phylogenetic tree with the phylogenetic tree of MMP13 depicting that, in the phylogenetic tree of MMP13, the Cebus imitator & Sapajus apella shares a recent common ancestor and these group share a common ancestor with Samiri bolivensis and all of these collectively share a common ancestor with Aotus nancymaae. When we comparing this with the standard phylogenetic tree Cebus imitator & Samiri bolivensis directly arrived from a common ancestor.

- Old World Monkeys: By analysing the group Cercopithecidae in the tree of MMP13, Papio Anubis & Theropithecis gelada share a recent common ancestor and they together share a common ancestor with Macaca group, Piliocolobus tephrosceles & Trachypithecus francoisi directly. But when we comparing this with the standard phylogenetic tree, they where not sharing a common ancestor directly, all of them share a common ancestor with other species recently, but all of them primitively share a common ancestor.

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Alignment: D:\Leyon\Evolution\MMP1\1-tree_for_seaview.txt
Seaview [blocks=10 fontsize=12 A4-landscape] on Wed Jan 31 07:26:41 2024

                              1
Homo_sapiens                  MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Mus_musculus                  MPSLP---LL LLLWAASSYS FPVFHNGDRQ NVETVWKYLE NYYNL---GK NMQAKNVNGK EMMAEKLRQM
Aotus_nancymaae               MHSYPP-LLL LLFWGVVSHG FPATLETQEQ DVEIVQKYLE QYYNLKNDGK QVEKKRSSGP --VVEKLKQM
Carlito_syrichta              MPSLP--LVL MLLWAVGSRG FPATSETREQ DVEIVQKYLE NYFNLKNDGK QFEKQRHSAP --VVEKLKEM
Cebus_imitator                MHSYPL-LLL LLFWGVVSHG FPATLETQEQ DVEIVQKYLE QYYNLKNDGK QVEKQRNSGP --VVEKLKQM
Gorilla_gorilla               MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Lemur_catta                   MPSFS--LLL LLLWGLGSHG FPAIPETQEQ DVEIVQKYLE NYYDLKNVGK QIEKKRSSGS --VVEKLKQM
Macaca_mulatta                MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDFVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Macaca_nemestrina             MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Microcebus_murinus            MPRFS--LLL LLLWSLGSHG LPVAPETQEQ DVEIVQKYLE NYYDLKNDGK QIEKKRNSGP --VVEKLKQM
Nomascus_leucogenys           MHSFPPLLLL LLFWSVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGL --VVEKLKQM
Nycticebus_coucang            MPSF---LLL LLLWGLGSHA FPAIPEPQEQ DVEIVQKYLE NYYDLKNDGS QIERKRNSGP --VVEKLKQM
Otolemur_garnettii            MSSFP--LLL LLLWGLGSHA LPVTPETQEQ DVEIVQKYLE NYYDLKNDGM QIERKRNSGP --VVEKLKQM
Pan_paniscus                  MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Pan_troglodytes               MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Papio_anubis                  MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Piliocolobus_tephrosceles     MHSFPPLLLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVQKQRNSGP --VVEKLKQM
Pongo_abelii                  MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Pongo_pygmaeus                MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Saimiri_boliviensis           MHSYPP-LLL LLFWSVVSHG FPATLETQEQ DVEIVQKYLE QYYDLKNDGK QVEKQRNSGP --VVEKLKQM
Sapajus_apella                MHSYPL-LLL LLFWGVVSHG FPATLETQEQ DVEIVQKYLE QYYNLKNDGK QVEKQRNSGP --VVEKLKQM
Symphalangus_syndactylus      MHSFPPLLLL LLFWSVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGL --VVEKLKQM
Theropithecus_gelada          MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Trachypithecus_francoisi      MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDRR QVEKQRNSGP --VVEKLKQM
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                             71
Homo_sapiens                 QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Mus_musculus                 QQLFGLKVTG NSDPETLRAM KKPRCGVPDV APYAITHNNP RWTKTHLTYS ILNYTPYLPK AVVEDAIARA
Aotus_nancymaae              QEFFGLKVTG KPDAETLNVM KQPRCGVPDV ARFVLTEGNP RWEKTHLTYR IENYTPDLPR ADVDQAIEKA
Carlito_syrichta             QKFFGLKVTG KPDPETLKVM KQPRCGVPDV AQFVLTEGNP RWQKTDLTYR IENYTPDLPK AEVDRAIEKA
Cebus_imitator               QEFFGLKVTG KPDAETLKVM KQPRCGVPDV ARFVLTEGNP RWKKTHLTYR IENYTPDLPR SDVDHAIEKA
Gorilla_gorilla              QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Lemur_catta                  QEFFGLKVTG KPDTETLKVM KQPRCGVPDV ARFVLTQGNP RWEQTHLTYR IENYTPDLPR ADVDLAIEKA
Macaca_mulatta               QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR AAVDQAIEKA
Macaca_nemestrina            QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR AAVDQAIEKG
Microcebus_murinus           QEFFGLKVTG KPDTETLKVM KQPRCGVPDV ARFVLTQGNP RWEKTHLTYR IENYTPDLSR ADVDHAIEKA
Nomascus_leucogenys          QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTAGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Nycticebus_coucang           QEFFGLKVTG TPDTETLKVM KQPRCGVPDV ARFALTPGNP RWEQTHLTYR IENYTPDLPR ADVDDAIEKA
Otolemur_garnettii           QEFFGLKVTG TPDTETLKVM KQPRCGVPDV ARFVLTQGNP RWEQTHLTYR IENYTPDLPK ADVDDAIEKA
Pan_paniscus                 QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIAKA
Pan_troglodytes              QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIAKA
Papio_anubis                 QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR AAVDQAIEKA
Piliocolobus_tephrosceles    QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDRAIEKA
Pongo_abelii                 QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Pongo_pygmaeus               QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Saimiri_boliviensis          QEFFGLKVTG KPDAETLNVM KQARCGVPDV ARFVLTEGNP RWEKTHLTYR IENYTPDLRR ADVDHAIEKA
Sapajus_apella               QEFFGLKVTG KPDAETLKVM KQPRCGVPDV ARFVLTEGNP RWEKTHLTYR IENYTPDLPR SDVDHAIEKA
Symphalangus_syndactylus     QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTAGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Theropithecus_gelada         QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR AAVDQAIEKA
Trachypithecus_francoisi     QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDRAIEKA
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                             141
Homo_sapiens                 FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Mus_musculus                 FRVWSDVTPL TFQRVFEEEG DIVLSFHRGD HGDNNPFDGP NYKLAHTFQP GPGLGGDVHY DLDETWTNSS
Aotus_nancymaae              FQLWSNVTPL TFTKVPKGQA DIMISFVRGD HQDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDETWTNNF
Carlito_syrichta             FQLWSNASPL RFTKVVEGQA DIMISFVRGD HQDNSPFYGP GENLAHAFQP GPNIGGDAHF DEDETWTNNI
Cebus_imitator               FQLWSNVTPL TFTKVPKGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GSGIGGDAHF DEDETWTNNF
Gorilla_gorilla              FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Lemur_catta                  FQLWSNASPL TFTKVFEGQA DIMISFVRGD HQDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDEQWTSDS
Macaca_mulatta               FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Macaca_nemestrina            FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Microcebus_murinus           FQLWSNASPL TFTRVFEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDEQWTNNF
Nomascus_leucogenys          FKLWSNVTPL TFTKVSEGQA DIMISFVRGD HQDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Nycticebus_coucang           FRLWSNASPL TFTKVFQGQA DIMISFVRGD HQDNSPFDGP GGNLAHAFQP GPGIGGDTHF DEDERWTNNL
Otolemur_garnettii           FQLWSNASPL TFTKVFQGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDEKWTNNL
Pan_paniscus                 FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Pan_troglodytes              FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Papio_anubis                 FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Piliocolobus_tephrosceles    FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Pongo_abelii                 FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Pongo_pygmaeus               FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Saimiri_boliviensis          FQLWSNVTPL TFTKVPKGQA DIMISFVRGD HQDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDETWTNNF
Sapajus_apella               FQLWSNVTPL TFTKVPKGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDETWTNNF
Symphalangus_syndactylus     FKLWSDVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DDDERWTNNF
Theropithecus_gelada         FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Trachypithecus_francoisi     FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
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                              211
Homo_sapiens                  REYNLHRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Mus_musculus                  ENFNLFYVTA HELGHSLGLT HSSDIGALMF PSYTWYTEDF VLNQDDINRI QDLYGPSPNP IQPTGATTPH
Aotus_nancymaae               REYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGKSQNP VQPTGPQTPQ
Carlito_syrichta              QNYNLYRVAA HEFGHSLGLS HSTDIGALMY PTYT-YSGDV QLAQDDIDGI QAIYGPSQNP IQPTGPQTPQ
Cebus_imitator                RGYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGQSPNP VQPTGPQTPQ
Gorilla_gorilla               REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Lemur_catta                   RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYT-FSGDV QLAQDDIDGI QAIYGPSQNP NQPTGPQTPQ
Macaca_mulatta                REYNLYRVAA HEFGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Macaca_nemestrina             REYNLYRVAA HELGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Microcebus_murinus            RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYA-FSGDV QLAQDDIDGI QAIYGPSQNP NQPIGPQTPQ
Nomascus_leucogenys           REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Nycticebus_coucang            RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYA-FSGEV ELAQDDIDGI QAIYGPSQNP IQPIGPQTPQ
Otolemur_garnettii            RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYA-FSGEV ELAQDDIDGI QAIYGPSQNP VQPTGPQTPQ
Pan_paniscus                  REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGHSQNP VQPIGPQTPK
Pan_troglodytes               REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Papio_anubis                  REYNLYRVAA HELGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Piliocolobus_tephrosceles     REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLSQDDIDGI QAIYGGSQNP VQPTGPQTPK
Pongo_abelii                  REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGPSQNP VQPIGPQTPK
Pongo_pygmaeus                REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGPSQNP VQPIGPQTPK
Saimiri_boliviensis           REYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGPSPNP VQPTGPQTPQ
Sapajus_apella                REYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGQSPNP VQPTGPQTPQ
Symphalangus_syndactylus      REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Theropithecus_gelada          REYNLYRVAA HELGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Trachypithecus_francoisi      REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
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                             281
Homo_sapiens                 ACDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Mus_musculus                 PCNGDLTFDA ITTFRGEVFF FKGRFYIRVN RFMPEPELNL IGILWPNLPV KLDAAYEASM IDQVRYFKGS
Aotus_nancymaae              VCDSKLTFDA ITTIRGEVFF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Carlito_syrichta             ACDSKISFDA VTTIRGEVMF FKDRFFMRTH PSYPEADLNF ISDFWPLLPN GLEAAYEDAG RDQVRFFKGY
Cebus_imitator               VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PYYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Gorilla_gorilla              VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLQAAYEFAD RDEVRFFKGN
Lemur_catta                  VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPS GLEAAYEVAS RDEVRFFKGN
Macaca_mulatta               VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Macaca_nemestrina            VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Microcebus_murinus           VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF VSVFWPQLPT GLEAAYEVAD RDEVRFFKGN
Nomascus_leucogenys          VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Nycticebus_coucang           VCDSKLTFDA VTTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPS GLEAAYEVVD RDEIRFFKGN
Otolemur_garnettii           VCDSKLTFDA VTTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEVAD RDEVRFFKGN
Pan_paniscus                 VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PSYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Pan_troglodytes              VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Papio_anubis                 VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Piliocolobus_tephrosceles    VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLQAAYEFAE RDEVRFFKGN
Pongo_abelii                 VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Pongo_pygmaeus               VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Saimiri_boliviensis          VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Sapajus_apella               VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PYYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Symphalangus_syndactylus     VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGK
Theropithecus_gelada         VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Trachypithecus_francoisi     VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLQAAYEFAD RDEVRFFKGN
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                            351
Homo_sapiens                KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Mus_musculus                KVWAVQEQSV LRGFPRDIHS FFGFPSNVTH IDAAVCEEET GKTYFFVDHM YWRYDENTQS MDPGYPRLTA
Aotus_nancymaae             KYWAAQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDAGYPKMIA
Carlito_syrichta            RFWAVQGQDV LRGYPQDIYS SYGFPRTVKH IDAAVFEEET GKTFFFVGNK YWRYDEYKRS MDVGYPKMIA
Cebus_imitator              KYWAVQGQNV LYGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDAGYPKKIA
Gorilla_gorilla             KYWAVQGQNM LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDPGYPKMIA
Lemur_catta                 KYWAVQGQNV LPGYPKDIYR SFGFPRTVKH IDAAISEEDT GKTYFFVANK YWRYDEYKQS MDTGYPKKLA
Macaca_mulatta              KYWAVQGQNV LPGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Macaca_nemestrina           KYWAVQGQNV LPGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Microcebus_murinus          KYWAVQGQNV LPGYPKDIYK SFGFPKTVKH IDAAVSEEDT GKTYFFVANK YWRYDEYKQS MDAGYPKMIA
Nomascus_leucogenys         KYWAVQGQNV LHGYPKDIYS SFGFPRTVKR INAALSEENT GKTYFFVAKK YWRYDEYKRS MDPGYPKMIA
Nycticebus_coucang          KYWAVRGQDV LHGYPKDISS SFGFPRTVKH VDAAVSEEET GKTYFFVANK YWRYDENKQS MDTGYPKMIA
Otolemur_garnettii          KYWAVRGPDV LHGYPKDISS SFGFPRTVKH VDAAVSEEET GKTYFFVANK YWRYDENKQS MDTGYPKTIA
Pan_paniscus                KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Pan_troglodytes             KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Papio_anubis                KYWAVQGQNV LPGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIS
Piliocolobus_tephrosceles   KYWAVQGQNV LRGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Pongo_abelii                KYWAVQGQNM LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEHKRS MDPGYPKMIA
Pongo_pygmaeus              KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Saimiri_boliviensis         KYWAVQGQNV LYGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDAGYPKMIA
Sapajus_apella              KYWAVQGQNV LYGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDAGYPKKIA
Symphalangus_syndactylus    KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVAKK YWRYDEYKRS MDPGYPKMIA
Theropithecus_gelada        KYWAVQGQNV LPGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK CWRYDEYKRS MDPGYPKMIA
Trachypithecus_francoisi    KYWAVQGQNV LRGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYERS MDPGYPKMIA
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                                 421
Homo_sapiens                      HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Mus_musculus                      EDFPGIDDKV DDVFQKGENF YFFHQSVQHR FNLQIRRVDD SRDSSTWFNC ---
Aotus_nancymaae                   DDFPGIGHKV DAVFMKDGFF YFFHKTRQYK FEPETKRILT LQKANSWFNC RKN
Carlito_syrichta                  HGFPGIGHKV DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKN
Cebus_imitator                    HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Gorilla_gorilla                   HDFPGIGHKV DAVFMKDGFF YFFRGRRQYK FDPETKRILT LQKANSWFNC RKN
Lemur_catta                       LDFPGIGHKI DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKK
Macaca_mulatta                    HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Macaca_nemestrina                 HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Microcebus_murinus                HDFPGIGHKI DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKN
Nomascus_leucogenys               HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Nycticebus_coucang                HDFPGIGHKV DAVFKKDEFF YFFHGTRQYK FDLKTKRILT LLKANSWFNC RKH
Otolemur_garnettii                HDFPGIGHKV DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKH
Pan_paniscus                      HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Pan_troglodytes                   HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Papio_anubis                      HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Piliocolobus_tephrosceles         HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Pongo_abelii                      HDFPGIGHKV DAVFTKDGFF YFFHGTRQYK FDPETKRILT LQKANSWFNC RKN
Pongo_pygmaeus                    HDFPGIGHKV DAVFTKDGFF YFFHGTRQYK FDPETKRILT LQKANSWFNC RKN
Saimiri_boliviensis               HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Sapajus_apella                    HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Symphalangus_syndactylus          HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Theropithecus_gelada              HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Trachypithecus_francoisi          HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
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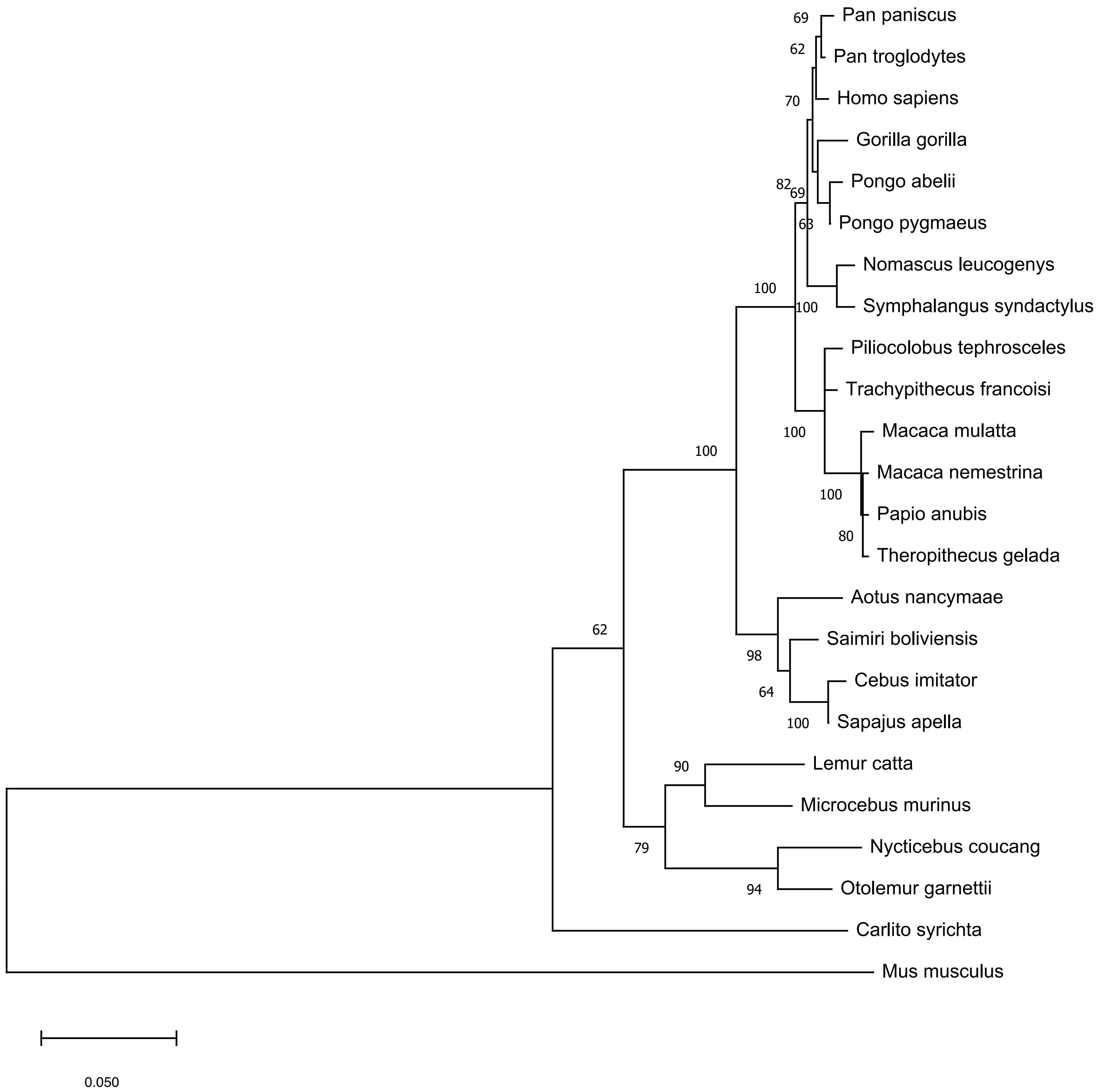
Pan paniscus
Pan troglodytes
Homo sapiens
Gorilla gorilla
Pongo abelii
Pongo pygmaeus
Nomascus leucogenys
Symphalangus syndactylus
Piliocolobus tephrosceles
Trachypithecus francoisi
Macaca mulatta
Macaca nemestrina
Papio anubis
Theropithecus gelada
Aotus nancymaae
Saimiri boliviensis
Cebus imitator
Sapajus apella
Lemur catta
Microcebus murinus
Nycticebus coucang
Otolemur garnettii
Carlito syrichta
Mus musculus
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Homo_sapiens                    MFSLKTLPFL LLLHVQISKA FPVSS--KEK NTKTVQ---- ------DYLE KFYQLPSNQY QSTRKNGTNV
Mus_musculus                    MFRLKTLPLL IFLHTQLANA FPVPEHLEEK NIKTAE---- ------NYLR KFYNLPSNQF RSSRN--ATM
Aotus_nancymaae                 MFCLKTLPFL LLLHVQISKA FPVSS--KEK DTKIVQ---- ------DYLE KFYQLPSNQY QSIRKNSINM
Carlito_syrichta                MFSLQMLLFL LLLHMQVATA FPTPS--EEK STTMVQ---- ------DYLE KFYQLPSSRY RSARKNSTSM
Cebus_imitator                  MFCLKTLPFL LLLHVQISKA FPVSS--KEK DTKIVQ---- ------DYLE KFYQLPSNQH QSIRKNSINM
Gorilla_gorilla                 MFSLKTLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- ------DYLE KFYQLPSNQY QSTRKNGTNV
Lemur_catta                     MFYLKTLPFL LLLHMELSKA FPVPS--EEK NAKIVQ---- ------DYLE KFYRLPSNQY RTARKNSPST
Macaca_mulatta                  MFSLKMLLFL LLLHVQISKA FPVSS--KEE NTKIVQ---- ------DYLE KFYQLPSNQY QSTRKNGTSM
Macaca_nemestrina               ---------- -------MQQ IP-------- QEKSIN---- ------DYLE KFYQLPSNQY QSTRKNGTSM
Microcebus_murinus              MFCLKTLPLL LLLHMELSKA FPVPS--EGR NAKIVQ---- ------DYLE KFYRLPSNQY RTARKNSASM
Nomascus_leucogenys             MFALKTLPFL LLLHVHISKA FPVSS--KEK NTKIVQ---- ------DYLE KFYQLPSNQY QSTRKNGTNV
Nycticebus_coucang              MFCLKTLLFL LLLHVQLSKT FPVVS--AEK NTKLIQ---- ------DYLE KFYQLPSNRY RTSRKNSTTM
Otolemur_garnettii              MFRLKTLVFL LLLHVPLSKT FPVVS--AEK NTKLIQ---- ------DYLE KFYQLPSNRY RTSRKNSTTM
Pan_paniscus                    MFSLKTLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- ------DYLE KFYQLPSNQY QSTRKNGTNV
Pan_troglodytes                 MFSLKMLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- ------DYLE KFYQLPSNQY QSTRKNGTNV
Papio_anubis                    MFSLKMLPFL LLLHVQISKA FPVSS--KEE NTKIVQ---- ------DYLE KFYQLPSNQY QSMRKNGTSM
Piliocolobus_tephrosceles       MFSLKTLPFL FLLHVQISKA FPVSS--KEE NTKIVQ---- ------DYLE KFYQLPSNQY QSTRKNGTSM
Pongo_abelii                    MFSLKTLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- ------DYLE KFYQLPSNQY QSTRKNGTNV
Pongo_pygmaeus                  -MCRFPRPFL YLLKRKIQKL FSTRP--SQK PTRCSHLILD FPASKIDYLE KFYQLPSNQY QSTRKNGTNV
Saimiri_boliviensis             MFCLKRLPFL LLLHVQISKA FPVSF--KEK DTKIVQ---- ------DYLE KFYQLPSNQY QSIRKNSINM
Sapajus_apella                  MFCLKTLPFL LLLHVQISKA FPVSS--KEK DTKIVQ---- ------DYLE KFYQLPSNQY QSIRKNSINM
Symphalangus_syndactylus        MFALKTLPFL LLLHVHISKA FPVSS--KEK NTKIVQ---- ------DYLE KFYQLPSNQY QSTRKNGTNV
Theropithecus_gelada            MFSLKMLPFL LLLHVQISKA FPVSS--KEE NTKIVQ---- ------DYLE KFYQLPSNQY QSTRKNGTSM
Trachypithecus_francoisi        MFSLKTLPFL LLLHVQISKA FPLSS--KEE NTKIVQ---- ------DYLE KFYQLPSNQY QSTRKNGTSM
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| | 71 | | | | | | |
|---|---|---|---|---|---|---|---|
| Homo_sapiens | IVEKLKEMQR | FFGLNVTGKP | NEETLDMMKK | PRCGVPDSGG | FMLTPGNPKW | ERTNLTYRIR | NYTPQLSEAE |
| Mus_musculus | VAEKLKEMQR | FFSLAETGKL | DAATMGIMEM | PRCGVPDSGD | FLLTPGSPKW | THTNLTYRII | NHTPQLSRAE |
| Aotus_nancymaae | IVEKLKEMQR | FFGLNVTGKP | NAETLEMMKQ | PRCGVPDSGD | FMITPGNPKW | EQTNLTYRII | NYTPQLSETE |
| Carlito_syrichta | IVEKLKEMQR | FFGLNVTGKP | DAETLETMEK | PRCGVPDRGD | FMLTPGNPKW | KHTNLTYRII | NYTPQLSEAD |
| Cebus_imitator | IVEKLKEMQQ | FFGLNVTGKP | NAETLEMMKQ | PRCGVPDSGD | FMITPGNPKW | EQTNLTYRII | NYTPQLSETE |
| Gorilla_gorilla | IVEKLKEMQR | FFGLNVTGKP | NEETLDMMKK | PRCGVPDSGG | FMLTPGNPKW | EHTNLTYRIR | NYTPQLSVAE |
| Lemur_catta | IVEKLKEMQR | FFRLNVTGKP | DAETLEVMEK | PRCGVPDSGD | FAITPGNPKW | EHTNLTYRII | SYTQQLSEAD |
| Macaca_mulatta | IVEKLKEMQR | FFGLNVTGKP | NEETLDMMKK | PRCGVPDSGD | FMLTPGNPKW | ERTNLTYSIL | NYTPQLSETD |
| Macaca_nemestrina | IVEKLKEMQR | FFGLNVTGKP | NEETLDMMKK | PRCGVPDSGD | FMLTPGNPKW | ERTNLTYSIL | NYTPQLSETD |
| Microcebus_murinus | VVEKLKEMQR | FFGLNVTGKP | DAETLEVMEK | PRCGVPDSSS | FMITPGSPKW | EHTNVTYRII | SHTQQLSVAE |
| Nomascus_leucogenys | IVEKLKEMQR | FFGLNVTGKP | NEETLDMMKK | PRCGVPDSGD | FMITPGNPKW | ERTNLTYRIR | NYTPQLSKAD |
| Nycticebus_coucang | IVEKLKEMQR | FFGLNVTGKP | NAETLEMMEK | PRCGVPDTAG | FVLTPGNPKW | EHINLTYRFI | NYTPQLSKTD |
| Otolemur_garnettii | IVEKLKEMQR | FFGLNVTGKP | NAETLEMMEK | PRCGVPDTAG | FMLTPGSPKW | EHTNLTYRFI | NYTPQLSKTD |
| Pan_paniscus | IIEKLKEMQR | FFGLNVTGKP | NEETLDMMKK | PRCGVPDSGG | FMLTPGNPKW | ERTNLTYRIR | NYTPQLSEAE |
| Pan_troglodytes | IVEKLKEMQR | FFGLNVTGKP | NEETLDMMKK | PRCGVPDSGG | FMLTPGNPKW | EHTNLTYRIR | NYTPQLSEAE |
| Papio_anubis | IVEKLKEMQR | FFGLNVTGKP | NEETLDMMKK | PRCGVPDSGD | FMLTPGNPKW | EHTNLTYRIL | NYTPQLSETD |
| Piliocolobus_tephrosceles | IVEKLKEMQR | FFGLNVTGKP | NEETLDMMKK | PRCGVPDTGD | FMLTPGNPKW | KHTNLTYSIL | NYTPQLSQTD |
| Pongo_abelii | IVEKLKEMQR | FFGLNVTGKP | NEETLDMMKK | PRCGVPDSGE | FMLTPGNPKW | ERTNLTYRIR | NYTPQLSEDD |
| Pongo_pygmaeus | IVEKLKEMQR | FFGLNVTGKP | NEETLDMMKK | PRCGVPDSGE | FMLTPGNPKW | ERTNLTYRIR | NYTPQLSEDD |
| Saimiri_boliviensis | IVEKLKEMQR | FFGLNVTGKP | DAETLEMMKQ | PRCGVPDSGD | FMITPGNPKW | EQTNLTYRFI | NYTPQLSVTE |
| Sapajus_apella | IVEKLKEMQQ | FFGLNVTGKP | NAETLEMMKQ | PRCGVPDSGD | FMITPGNPKW | EQTNLTYRII | NYTPQLSETE |
| Symphalangus_syndactylus | IVEKLKEMQR | FFGLNVTGKP | NEETLDMMKK | PRCGVPDSGD | FMITPGNPKW | ERTNLTYRIR | NYTPQLSKTD |
| Theropithecus_gelada | IVEKLKEMQR | FFGLNVTGKP | NEETLDMMKK | PRCGVPDSGD | FMLTPGNPKW | ERTNLTYRIL | NYTPQLSETD |
| Trachypithecus_francoisi | IVEKLKEMQR | FFGLNVTGKP | NEETLDMMKK | PRCGVPDTGD | FMLTPGNPKW | KHTNLTYSIL | NYTPQLSKTD |

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                             141
Homo_sapiens                 VERAIKDAFE LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Mus_musculus                 VKTAIEKAFH VWSVASPLTF TEILQGEADI NIAFVSRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDS
Aotus_nancymaae              VETAIGNAFK VWSNASSLTF TRISQGEANI SIAFFHRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDA
Carlito_syrichta             VDSAIERAFE LWSHASPLRF TRISQGEPDI KIAFVQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Cebus_imitator               VERAIGDAFK VWSDVSPLTF TRISQGEADI NIAFYQKDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Gorilla_gorilla              VERAIKDAFE LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Lemur_catta                  VETAIEKAFK VWSDVSPLTF TRISRGEADI KIAFYLRDHG DNSPFDGPNG ILAHAFQPGR GIGGDVHFDA
Macaca_mulatta               VEGAIKKAFE VWSKASPLTF TRISQGQADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Macaca_nemestrina            VEGAIKKAFE VWSKASPLTF TRISQGQADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Microcebus_murinus           VGAAFEKAFK LWSGASPLTF TRISQGEADI KIAFVQRDHG DNSPFDGPNG ILAHAFQPGP GIGGDVHFDA
Nomascus_leucogenys          VERAIEKAFK VWSDASPLTF TRISQGEADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Nycticebus_coucang           VETVIEKAFE VWSKASPLTF TKISQGEADI KIAFVRREHG DNSPFDGPNG ILAHAFQPGR GIGGDVHFDE
Otolemur_garnettii           VETVIEKAFE VWSKASPLTF TKTAQGEADI KIAFVQKDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDE
Pan_paniscus                 VERAIKDAFK LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Pan_troglodytes              VERAIKDAFE LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Papio_anubis                 VEGAIKKAFE VWSKASPLTF TRISQGQADI NIGFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Piliocolobus_tephrosceles    VEGTIKKAFE VWSKVSPLTF TRISQGDADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Pongo_abelii                 VKTAIEKAFE VWSKASPLTF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDA
Pongo_pygmaeus               VKTAIEKAFE VWSKASPLTF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDA
Saimiri_boliviensis          VETAIGNAFK IWSDPSPLTF TRISQGEADI NIAFFPRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Sapajus_apella               VETAIGDAFK VWSDVSPLTF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Symphalangus_syndactylus     VERAIEKAFK VWSDASPLTF TRISQGEADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Theropithecus_gelada         VEGAIKKAFE VWSKASPLTF TRISQGQADI NIGFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Trachypithecus_francoisi     IEGAIKKAFE VWSKVSPLTF TRISQGEADI NIGFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
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211

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Homo_sapiens | EETWTNTSAN | YNLFLVAAHE | FGHSLGLAHS | SDPGALMYPN | YAFRETSNYS | LPQDDIDGIQ | AIYGLSSNPI |
| Mus_musculus | EETWTQDSKN | YNLFLVAAHE | FGHSLGLSHS | TDPGALMYPN | YAYREPSTYS | LPQDDINGIQ | TIYGPSDNPI |
| Aotus_nancymaae | EETWTSTSKN | YNLFLVAAHE | FGHSLGLSHS | SDPGALMYPN | YAFREPSTYS | LPQDDINGIQ | AIYGPSSNPI |
| Carlito_syrichta | EETWTKTSAN | YNLFLVAAHE | FGHSLGLSHS | SDPGALMYPN | YAFREPSTYL | LPQDDINGIQ | AIYGPSDNPI |
| Cebus_imitator | EETWTNTSEN | YNLFLVAAHE | FGHSLGLSHS | SDPGALMYPN | YAFREPSTYS | LPQDDINGIQ | AIYGPSSNPI |
| Gorilla_gorilla | EETWTNTSAS | YNLFLVAAHE | FGHSLGLAHS | SDPGALMYPN | YAFRETSNYS | LPQDDIDGIQ | AIYGLSSNPI |
| Lemur_catta | EETWTTNANN | YNLFLVAAHE | FGHSLGLAHS | SDPGALMYPN | YAFREPSTYT | LPQDDINGIQ | AIYGPSSNPV |
| Macaca_mulatta | EETWTKTSTN | YNLFLVAAHE | FGHSLGLAHS | SDPGALMYPN | YAFRETSNYS | LPQDDINGIQ | AIYGPSSNPI |
| Macaca_nemestrina | EETWTKNSTN | YNLFLVAAHE | FGHSLGLAHS | SDPGALMYPN | YAFRETSNYS | LPQDDINGIQ | AIYGPSSNPI |
| Microcebus_murinus | EETWTTNFNN | YNLFLVAAHE | FGHSLGLAHS | SDAGALMYPN | YAFSEPSTYT | LPQDDINGIQ | AIYGPSNNPI |
| Nomascus_leucogenys | EETWTKTSTN | YNLFLVAAHE | FGHSLGLAHS | SDPGALMYPN | YAFRETSTYS | LPQDDIDGIQ | AIYGPSSNPI |
| Nycticebus_coucang | EETWTTTAVN | YNLFLVAAHE | FGHSLGLSHS | TDPGALMYPN | YAFNDPSTYS | LPQDDINGIQ | AIYGPSSSPV |
| Otolemur_garnettii | EETWTTTSIN | YNLFLVAAHE | FGHSLGLSHS | SDPGALMYPN | YAFNEPSTYS | LPQDDINGIQ | AIYGPSNSPV |
| Pan_paniscus | EETWTDTSAN | YNLFLVAAHE | FGHSLGLAHS | SDPGALMYPN | YAFRETSNYS | LPQDDIDGIQ | AIYGLSSNPI |
| Pan_troglodytes | EETWTDTSAN | YNLFLVAAHE | FGHSLGLAHS | SDPGALMYPN | YAFRETSNYS | LPQDDIDGIQ | AIYGLSSNPI |
| Papio_anubis | EETWTKDFTN | YNLFLVAAHE | FGHSLGLAHS | SDPGALMYPN | YAFRETSNYS | LPQDDINGIQ | AIYGPSSNPI |
| Piliocolobus_tephrosceles | EETWTTNSTN | YNLFLVAAHE | FGHSLGLAHS | FDPGALMYPN | YAFRETSNYS | LPQDDINGIQ | AIYGPSSNPI |
| Pongo_abelii | EETWTKTSAN | YNLFIVAAHE | FGHSLGLAHS | SDPGALMYPN | YAFTETSNYS | LPQDDIDGIQ | AIYGPSSNPV |
| Pongo_pygmaeus | EETWTKTSAN | YNLFIVAAHE | FGHSLGLAHS | SDPGALMYPN | YAFTETSNYS | LPQDDIDGIQ | AIYGPSSNPV |
| Saimiri_boliviensis | EETWTSTSEN | YNLFLVAAHE | FGHSLGLSHS | SDPGALMYPN | YAFREPSTYS | LPQDDINGIQ | AIYGPSSNPI |
| Sapajus_apella | EETWTNTPEN | YNLFLVAAHE | FGHSLGLSHS | SDPGALMYPN | YAFREPSTYS | LPQDDINGIQ | AIYGPSSNPI |
| Symphalangus_syndactylus | EETWTKTSAN | YNLFLVAAHE | FGHSLGLAHS | SDPGALMYPN | YAFRETSTYS | LPQDDIDGIQ | AIYGPSSNPI |
| Theropithecus_gelada | EETWTKDFTN | YNLFLVAAHE | FGHSLGLAHS | SDPGALMYPN | YAFRETSNYS | LPQDDINGIQ | AIYGPSSNPI |
| Trachypithecus_francoisi | EETWTTNSTN | YNLFLVAAHE | FGHSLGLAHS | FDPGALMYPN | YAFRETSNYS | LPQDDINGIQ | AIYGPSSNPI |

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Homo_sapiens              QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Mus_musculus              QPTGPSTPKA CDPHLRFDAT TTLRGEIYFF KDKYFWRRHP QLRTVDLNFI SLFWPFLPNG LQAAYEDFDR
Aotus_nancymaae           QPTGPSTPRP CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Carlito_syrichta          QPTGPSTPRT CDPRLTFDAI TTLRGEIFFF RDKYFWRRHP QLRSIEFNFI SLFWPALPDS IQAAYEDLDR
Cebus_imitator            QPTGPSTPRP CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Gorilla_gorilla           QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Lemur_catta               QPTGPSTPRS CDPRLTFDAI TTLRGEILFF KDKYFWRRHP QLRSVELNFI SLFWPNLPNG IQAAYEDFDR
Macaca_mulatta            QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Macaca_nemestrina         QPTGPTTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Microcebus_murinus        QPTGPSTPMA CDPRLTFDAI TTLRGEIFFF KDKYFWRRHP QLRSVELNFI SLFWPSLPNG IQAAYEDFDK
Nomascus_leucogenys       QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDSDR
Nycticebus_coucang        QPTGPSTPRT CDPRLTFDAI TTLRGEILFF KDKYFWRKHP QLPTVELNFI SLFWPSLPNG IQAAYEDFDR
Otolemur_garnettii        QPTGPSTPRT CDPRLTFDAI TTLRGEILFF KDKYFWRKHP QLPTAELNFI SLFWPSLPNG IQAAYEDFER
Pan_paniscus              QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Pan_troglodytes           QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Papio_anubis              QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Piliocolobus_tephrosceles QPTGPSTPES CDPRLTFDAI TTLRGEILFF KDEYFWRRHP WLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Pongo_abelii              QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRIEMNFI SLFWPSLPTG MQAAYEDFDR
Pongo_pygmaeus            QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRIEMNFI SLFWPSLPTG MQAAYEDFDR
Saimiri_boliviensis       QPTGPSTPRS CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLRRVEMNFI SLFWPSLPTG IQAAYEDFDR
Sapajus_apella            QPTGPSTPRP CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Symphalangus_syndactylus  QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Theropithecus_gelada      QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Trachypithecus_francoisi  QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
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                             351
Homo_sapiens                 DLIFLFKGNQ YWALSGYDIL QGYPKDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Mus_musculus                 DLVFLFKGRQ YWALSGYDLQ QGYPRDISNY GFPRSVQAID AAVSYNGKTY FFINNQCWRY DNQRRSMDPG
Aotus_nancymaae              DLVFLFKGNQ YWALSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Carlito_syrichta             DLVFLFKGNQ YWAMNGYDLQ PGYPRDISNY GFPSNVQAID AAVYFRSKTY FFVNDQFWRY DNERQTMEPG
Cebus_imitator               DLVFLFKGNQ YWALSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQLMEPG
Gorilla_gorilla              DLIFLFKGNQ YWALSGYDIL QGYPKDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Lemur_catta                  DLVFLFKGNQ YWALSGYDIQ QGYPRYISNY GFPSTVQAID AAVSYGSETY FFVNDQFWRY DNQRQAMDPG
Macaca_mulatta               DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Macaca_nemestrina            DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Microcebus_murinus           DLVFLFKGNQ YWAMSGYDIQ QGYPRHISNY GFPSNVQAID AAVSYGRKTY FFVNDQLWRY DNQRQAMDPG
Nomascus_leucogenys          DLIFLFKGNQ YWALSGYDIQ QGYPKSISNY GFPCSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Nycticebus_coucang           DLVFLFKGNQ YWALNGYDIQ EGYPRDISNY GFPSTVQAID AAVSYRRKTY FFVNDQFWRY DNQRQLMEPG
Otolemur_garnettii           DLVFLFKGNQ YWALNGYEIQ QGYPRDISNY GFPSTVQAVD AAVFYRRKTY FFVNDQFWRY DNQRQFMEPG
Pan_paniscus                 DLIFLFKGNQ YWALSGYDIL QGYPKDIANY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Pan_troglodytes              DLIFLFKGNQ YWALSGYDIL QGYPKDIANY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Papio_anubis                 DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Piliocolobus_tephrosceles    DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Pongo_abelii                 DLIFLFKGNQ YWALSGYDIL QGYPKNISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Pongo_pygmaeus               DLIFLFKGNQ YWALSGYDIL QGYPKNISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Saimiri_boliviensis          DLVFLFKGNQ YWALSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYKSKTY FFVNDQFWRY DNQRQFMEPG
Sapajus_apella               DLVFLFKGNQ YWALSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQLMEPG
Symphalangus_syndactylus     DLIFLFKGNQ YWALSGYDIQ QGYPKSISNY GFPCSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Theropithecus_gelada         DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Trachypithecus_francoisi     DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
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Mus_musculus                  YPKSIPSMFP GVNCRVDAVF LQDSFFLFFS GPQYFAFNFV SHRVTRVARS NLWLNCS--
Aotus_nancymaae               YPQSISYIFP GIESKVDAVF QQEHFFLFFS GPLYYAFDLS AQRVTRVARG NKWLNCR--
Carlito_syrichta              YPKSTLSIFP GIESKVDAVF QQNYFFFFFS GPRFYAFDLQ AHRVTRVDRS NRWLNCR--
Cebus_imitator                YPQRISDIFP GIERKVDAVF QQEHFFLFFS GPIYYAFDLS AQRVTRVARG NKWLNCR--
Gorilla_gorilla               YPKSISGAFP GIESKVDAVF QQQHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Lemur_catta                   YPQSILRTFP GIQSKVDAVF QKDDFFLFFS GPLYYAFNLS TRRVTRIDRS NKWLNCR--
Macaca_mulatta                YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Macaca_nemestrina             YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Microcebus_murinus            YPQSISSTFP GIQSRVDAVF QQDDFFLFFS GPRYYAFNLS TNRVTRLDKS NKWLNCR--
Nomascus_leucogenys           YPKSISGTFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVERG NKWLNCRYG
Nycticebus_coucang            YPKSLSTAFP GIESRVDAVF QRDYVFLFFS GPRYYAFDLN TRRVIRIDRS NIWLNCR--
Otolemur_garnettii            YPKSISTAFP GIESRVDAVF HRDYVFVFFS GPRYYAFDLN TRRVIRIDRS NKWLNCR--
Pan_paniscus                  YPKSISGAFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Pan_troglodytes               YPKSISGAFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Papio_anubis                  YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Piliocolobus_tephrosceles     YPKSTSGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTTVARA NEWLNCRYS
Pongo_abelii                  YPKSISDTFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Pongo_pygmaeus                YPKSISDTFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCR--
Saimiri_boliviensis           YPQSISGIFP GIESKVDAVF QQEHFFLFFS GPIYYAFDLS AQRVTKIARG NKWLNCR--
Sapajus_apella                YPQRISDIFP GIERKVDAVF QQEHFFLFFS GPIYYAFDLS AQRVTRVARG NKWLNCR--
Symphalangus_syndactylus      YPKSISDTFP GIESKVDAVF QQERFFLFFS GPRYYAFDLI AQRVTRVERG NKWLNCRYG
Theropithecus_gelada          YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Trachypithecus_francoisi      YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
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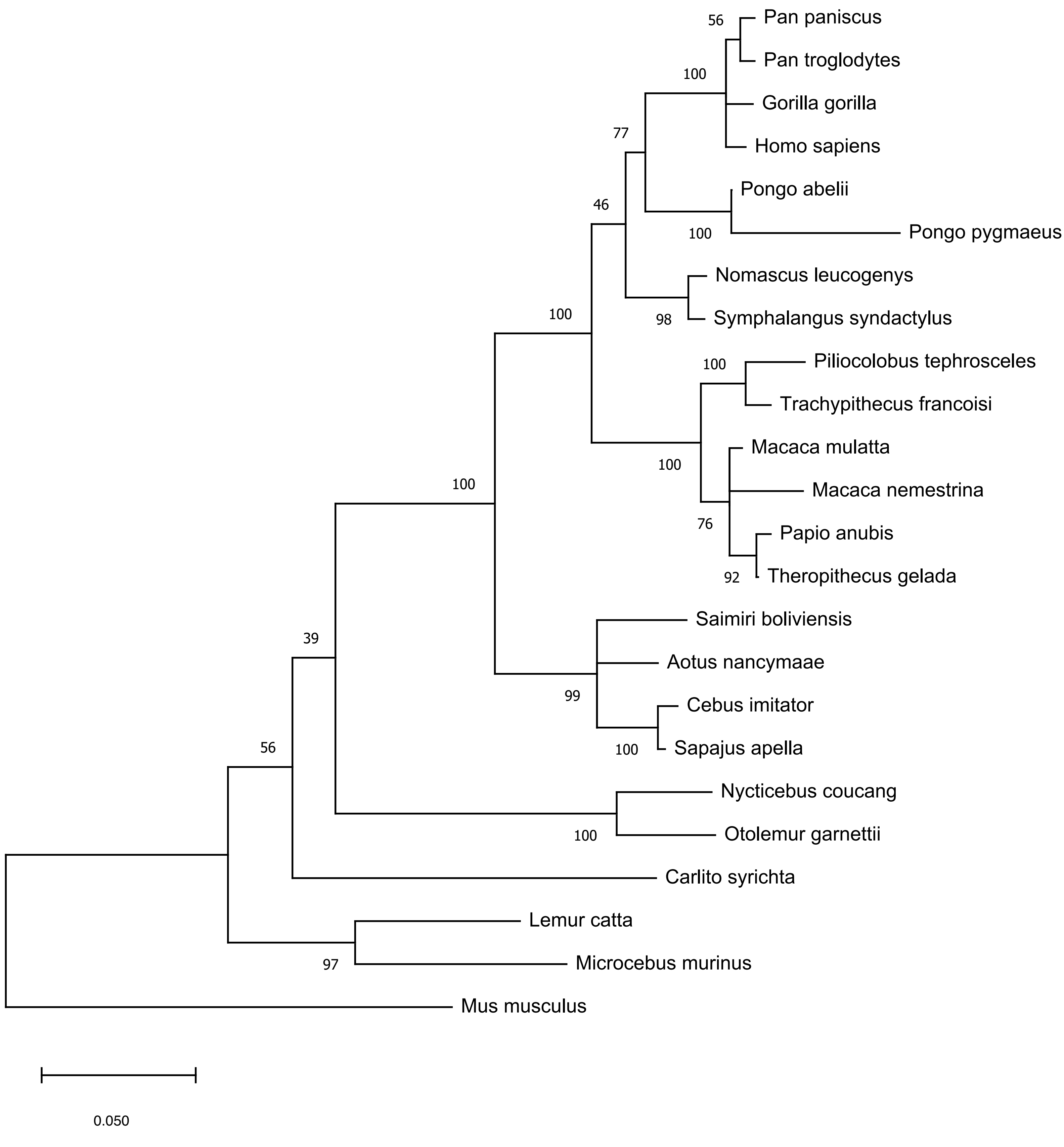
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Pan paniscus
Pan troglodytes
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Gorilla gorilla
77
Homo sapiens
Pongo abelii
46
100
Pongo pygmaeus
Nomascus leucogenys
100
98
Symphalangus syndactylus
100
Piliocolobus tephrosceles
Trachypithecus francoisi
Macaca mulatta
100
100
Macaca nemestrina
76
Papio anubis
92
Theropithecus gelada
Saimiri boliviensis
39
Aotus nancymaae
99
Cebus imitator
56
100
Sapajus apella
Nycticebus coucang
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Otolemur garnettii
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Lemur catta
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Microcebus murinus
Mus musculus
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Mus_musculus                 MHSAILATFF LLSWTPCWSL PLPYGDDDDD DLSEEDLVFA EHYLKSYYHP ATLAGILKKS TVTSTVDRLR
Aotus_nancymaae              MHLGVLAAFL FLNWTHCRAL PLPNG-DDED DLSEEDLQFA ERYLKLYYHP TNLAGILKKN SANSMADRLR
Carlito_syrichta             MHPGVLTAFL LLCWTQCQSL PLPNG-EDED DTSEEDLQFA ERYLRSFYHP VNLAGILKKN AASSMVDRLR
Cebus_imitator               MHPGVLAAFL FLSWTHCWAL PLPNG-DDED DLSEEDLQFA ERYLKLYYHP TNLAGILKKN SASSMTDRLR
Gorilla_gorilla              MHPGVLAAFL FLSWTHSRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Lemur_catta                  MHPGILVAFL FLSWTHCRSL PLPNG--DDD DLSEEDLQFA ERYLKSYYHP PNLAGILKET SASSMVDRLR
Macaca_mulatta               MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Macaca_nemestrina            MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Microcebus_murinus           -MQGVLVAFL FLSWTHCRSL PLPDG--DDD DLSEEDLQFA ERYLKSYYHP PILAGILKKT SASSMVDRLR
Nomascus_leucogenys          MHPGILAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Nycticebus_coucang           MLPGVLLAFL FLSWTHCRAL PLPND-DDDD DLSEEDLQFA ERYLKSYYYP PNLAGILKKT SASSMIDRLR
Otolemur_garnettii           MLPRVLLAFL FLSWTPCRAL PLPNG--DDD DLSEEDLQFA EHYLKSYYHP LNLAGILKKT SASSMIDRLR
Pan_paniscus                 MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTERLR
Pan_troglodytes              MHPGVLAAFL FLSWAHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTERLR
Papio_anubis                 MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Piliocolobus_tephrosceles    MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Pongo_abelii                 MHPGVLAAFL FLSWTHCRAL PLPSD-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Pongo_pygmaeus               MHPGVLAAFL FLSWTHCRAL PLPSD-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Saimiri_boliviensis          MHPGVLAAFL FLSWTHCRAL PLPNG-DDED DLSEEDLQFA ERYLKLYYHP TNLAGILKKN SASSMTDRLR
Sapajus_apella               MHPGVLAAFL FLSWTHCWAL PLPNG-DDED DLSEEDLQFA EHYLKLYYHP TNLAGILKKN SASSMTDRLR
Symphalangus_syndactylus     MHPGILAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Theropithecus_gelada         MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Trachypithecus_francoisi     MHPVVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
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Homo_sapiens                 EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Mus_musculus                 EMQSFFGLEV TGKLDDPTLD IMRKPRCGVP DVGEYNVFPR TLKWSQTNLT YRIVNYTPDM SHSEVEKAFR
Aotus_nancymaae              EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Carlito_syrichta             EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIENYTPDM PHSEVEKAFK
Cebus_imitator               EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWPKMNLT YRIVNYTPDM THSEVEKAFK
Gorilla_gorilla              EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Lemur_catta                  EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWTQTNLT YRIVNYTPDM PHSEVEKAFK
Macaca_mulatta               EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
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Microcebus_murinus           EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWTQTNLT YRIVNYTPDM THSEVEKAFK
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Pan_paniscus                 EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Pan_troglodytes              EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Papio_anubis                 EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
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Saimiri_boliviensis          EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWSRMNLT YRIVNYTPDM THSEVEKAFK
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Symphalangus_syndactylus     EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
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Trachypithecus_francoisi     EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWSKVNLT YRIVNYTPDM THSEVEKAFK
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Mus_musculus                KAFKVWSDVT PLNFTRIYDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Aotus_nancymaae             KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Carlito_syrichta            KAFKVWSDVT PLNFTRMHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Cebus_imitator              KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Gorilla_gorilla             KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Lemur_catta                 KAFKVWSDVT PLNFTRLHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Macaca_mulatta              KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Macaca_nemestrina           KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Microcebus_murinus          KAFKVWSDVT PLNFTRLHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNLGGDA HFDDDETWTS
Nomascus_leucogenys         KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Nycticebus_coucang          KAFKVWSDVT PLNFTRLHDG TADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Otolemur_garnettii          KAFKVWADVT PLNFTRLHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pan_paniscus                KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pan_troglodytes             KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Papio_anubis                KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Piliocolobus_tephrosceles   KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pongo_abelii                KAFKVWSDVT PLNFTRLHNG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pongo_pygmaeus              KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Saimiri_boliviensis         KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Sapajus_apella              KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
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Theropithecus_gelada        KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
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Carlito_syrichta             SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK NHFVLPDDDV QGIQTLYGPG DEDPNPKHPK
Cebus_imitator               SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTSK SHFMLPDDDV QGIQFLYGPG DEDPNPKHPK
Gorilla_gorilla              SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
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Macaca_mulatta               SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
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Microcebus_murinus           SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFVLPDDDV QGIQSLYGPG DEDPNPKHPK
Nomascus_leucogenys          SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Nycticebus_coucang           SSKGYNLFLV AAHELGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPEDDV QGIQFLYGPG DEDPNPKHPK
Otolemur_garnettii           SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFVLPEDDV QGIQSLYGPG DEDPNPKHPK
Pan_paniscus                 SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Pan_troglodytes              SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Papio_anubis                 SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFVLPDDDV QGIQSLYGPG DEDPNPKHPK
Piliocolobus_tephrosceles    SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Pongo_abelii                 SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Pongo_pygmaeus               SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Saimiri_boliviensis          SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTSK NHFMLPDDDV QGIQFLYGPG DEDPNPKHPK
Sapajus_apella               SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTSK SHFMLPDDDV QGIQFLYGPG DEDPNPKHPK
Symphalangus_syndactylus     SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Theropithecus_gelada         SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFVLPDDDV QGIQSLYGPG DEDPNPKHPK
Trachypithecus_francoisi     SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
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Aotus_nancymaae              TPDKCDPSLS LDAITSLRGE TMVFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSRDLIFIF
Carlito_syrichta             TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSRDLIFIF
Cebus_imitator               TPDKCDPSLS LDAITSLRGE TMVFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Gorilla_gorilla              TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSYDLIFVF
Lemur_catta                  TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPAHDLVFVF
Macaca_mulatta               TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Macaca_nemestrina            TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Microcebus_murinus           TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLVFFF
Nomascus_leucogenys          TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Nycticebus_coucang           TPDKCDPSLS LDAITSLRGE TIIFKDRFFW RLHPQQVDAE LFLTKSFWME LPNRIDAAYE HPSHDLVFIF
Otolemur_garnettii           TPDKCDPSLS LDAITNLRGE TIIFKDRFFW RLHPQQVDAE LFLTKSFWLE LPNRIDAAYE HPSHDLVFIF
Pan_paniscus                 TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Pan_troglodytes              TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Papio_anubis                 TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Piliocolobus_tephrosceles    TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
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Sapajus_apella               TPDKCDPSLS LDAITSLRGE TMVFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Symphalangus_syndactylus     TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Theropithecus_gelada         TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
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Theropithecus_gelada          RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Trachypithecus_francoisi      RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
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Microcebus_murinus            IEEDFPGIGD KVDAVYEKNG YIYFFSGPIQ FEY------- ---------- ---SIWSNRI VRVMPTNSLL
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Sapajus_apella                IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSKRI VRVMPANSIL
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Theropithecus_gelada          IEEDFPGIGD KVDAVYEKNE SHFVVQAGVQ WHNLSSLQPP PPGFKRFSCL SLRSSWNYRL YLFFQRAHTV
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| Cebus_imitator | WC |
| Gorilla_gorilla | WC |
| Lemur_catta | WC |
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| Macaca_nemestrina | LC |
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| Pan_troglodytes | WC |
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| Pongo_abelii | WC |
| Pongo_pygmaeus | WC |
| Saimiri_boliviensis | WC |
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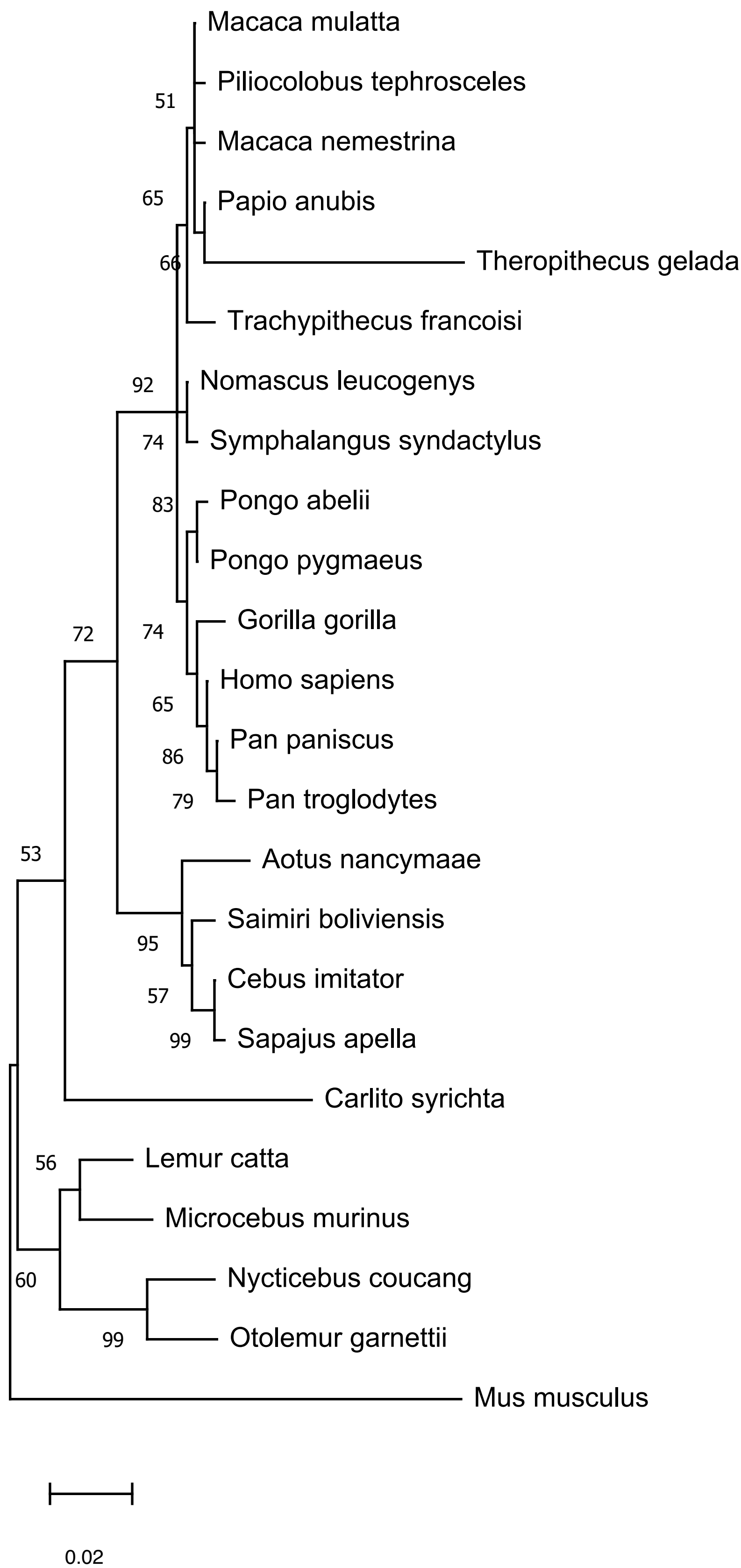
| Trachypithecus_francoisi | WC |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Macaca nemestrina
Papio anubis
Theropithecus gelada
Trachypithecus francoisi
Nomascus leucogenys
Symphalangus syndactylus
Pongo abelii
Pongo pygmaeus
Gorilla gorilla
Homo sapiens
Pan paniscus
Pan troglodytes
Aotus nancymaae
Saimiri boliviensis
Cebus imitator
Sapajus apella
Carlito syrichta
Lemur catta
Microcebus murinus
Nycticebus coucang
Otolemur garnettii
Mus musculus
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A glimpse on the discussions…

# A STUDY ON GRASSHOPPER DIVERSITY IN CHRIST COLLEGE (AUTONOUMOUS), IRINJALAKUDA

DEPARTMENT OF ZOOLOGY,
CHRIST COLLEGE (AUTONOMOUS),
IRINJALAKUDA
THRISSUR, KERALA-680 125

MARCH 2024

# A STUDY ON GRASSHOPPER DIVERSITY IN CHRIST COLLEGE IRINJALAKUDA

***Project report submitted to the University of Calicut in partial fulfillment of the requirement for the award of the Degree***

## BACHELOR OF SCIENCE IN ZOOLOGY

| Sl No. | Group members | Register No. |
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| 2. | ALEENA MARIYA | CCAVSZO016 |
| 3. | ANAGHA ARUN M A | CCAVSZO004 |
| 4. | ANAGHA SAIBU | CCAVSZO018 |
| 5. | ANJIMA JOSE | CCAVSZO020 |
| 6. | MARIYA T J | CCAVSZO028 |
| 7. | NEETHU N M | CCAVSZO009 |
| 8. | RAHMA | CCAVSZO011 |
| 9 | SANDRA K SHAJU | CCAVSZO032 |

**DEPARTMENT OF ZOOLOGY**
**CHRIST COLLEGE (AUTONOMOUS) IRINJALAKUDA**
**THRISSUR, KERALA 680125**

**Examiners:**

**1.**

**2.**

# DECLARATION

We, Akshay K A, Aleena Mariya, Anagha Arun M A, Anagha Saibu, Anjima Jose, Mariya T J, Neethu N M, Rahma and Sandra K Shaju, do hear by declare that this project entitled "**Study on grasshopper diversity in Christ College (Autonomous), Irinjalakuda**" is a genuine record of project work done by us under the guidance of Dr. Bijoy C., Assistant Professor, Department of Zoology, Christ College (Autonomous), Irinjalakuda, and has not been submitted to any university or Institution for the Award of any Degree or Diploma.

We further declare that results presented in this work and considerations made therein, contribute in general to the advancement of knowledge in science.

| Sl. No | Register Number | Name | Signature |
|---|---|---|---|
| 1 | CCAVSZO002 | AKSHAY K A | |
| 2 | CCAVSZO016 | ALEENA MARIYA | |
| 3 | CCAVSZO004 | ANAGHA ARUN M A | |
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| 7 | CCAVSZO009 | NEETHU N M | |
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| 9 | CCAVSZO032 | SANDRA K SHAJU | |

Place: Irinjalakuda

Date:

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**Dr Bijoy C.**
**Assistant Professor,**
**Research Department of Zoology,**
**drbijoyc@gmail.com**
**Mob: 9895551003**

# CERTIFICATE

This is to certify that the content of this project work entitled "**STUDY ON GRASSHOPPER DIVERSITY IN CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA**" is an original work done by the following students under my supervision and guidance at the Department of Zoology, Christ College (Autonomous), Irinjalakuda. I further certify that no part of the work has been presented for the award of any other Degree or Diploma.

| Sl. No | Register Number | Group members |
|---|---|---|
| 1 | CCAVSZO002 | AKSHAY K A |
| 2 | CCAVSZO016 | ALEENA MARIYA |
| 3 | CCAVSZO004 | ANAGHA ARUN M A |
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| 6 | CCAVSZO028 | MARIYA T J |
| 7 | CCAVSZO009 | NEETHU N M |
| 8 | CCAVSZO011 | RAHMA |
| 9 | CCAVSZO032 | SANDRA K SHAJU |

**Place:** Irinjalakuda

**Date:**

**Dr. Bijoy C.**

Project Supervisor

## CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA

## DEPARTMENT OF ZOOLOGY

## CERTIFICATE

This is to certify that the project work entitled **'A study on grasshopper diversity in Christ College (Autonomous) Irinjalakuda'** is an authentic record of research work carried out by **Akshay K A, Aleena Mariya, Anagha Arun M A, Anagha Saibu, Anjima Jose, Mariya T J, Neethu N M, Rahma** and **Sandra K Shaju** as a part of B.Sc. practical during the year 2022- 2023 and the results of this work has not been presented for the award of any other degree/diploma in any university.

Place: Irinjalakuda

Date:

**Dr. Sudhikumar A. V.**

Head, Department of Zoology,

Christ College, Irinjalakuda

## ACKNOWLEDGMENTS

The success and final outcome of this project required a lot of guidance and assistance from people. Whatever we have done is only due to such guidance and assistance and we would like to express our gratitude to the following individuals without whom the work would not have been completed.

Firstly, we would like to express our heartfelt gratitude to the Almighty for providing us with the strength, wisdom, and perseverance throughout the course of this project.

We would like to express our sincere gratitude to Dr Bijoy C, Assistant Professor, Department of Zoology, Christ College, Irinjalakuda, for providing necessary advice, for his patience in bearing our ideas, and for all the efforts he made to see this project through to completion. This study would not be possible without his tremendous help and guidance. His dedication to academic excellence has been truly inspiring.

We are deeply indebted to Dr A.V. Sudhikumar, Head of Department of zoology, Christ College, Irinjalakuda, as well as all other teaching and non-teaching department personnel, for the suggestions.

We are also grateful to Rev. Dr Jolly Andrews CMI, Principal of Christ College Irinjalakuda, for providing all available resources for this project and for fostering an environment of learning and excellence at college.

We are immensely grateful to Ms. Thasnim E S, Research scholar at Shadpada Entomology Research Lab (SERL), Christ College, Irinjalakuda, for the identification of specimens, providing necessary ideas from the start of this project and for her valuable insights, and contributions to this project. Her dedication and expertise have been invaluable assets throughout the process.

Lastly, we extend our heartfelt thanks to our family for their encouragement, and support during the field trips.

# CONTENTS

# ABSTRACT

The present study is an attempt to find the diversity of grasshoppers in Christ College campus, to calculate the relative abundance of collected grasshoppers and to study their variations according to seasons and habitats. The study was carried out in four sites of Christ College campus, Irinjalakuda, Thrissur district, Kerala. Collection was done on two different seasonal period from monsoon to post monsoon. Post monsoon has the maximum species richness and monsoon shows more species diversity. According to our study, we observed 19 grasshopper species, Family Acrididae is the most abundant and Family Tetrigidae has the least abundance.

# A Bioinformatic Study on the Molecular Evolution of Collagenases in Primates

*A project report submitted to the* ***University of Calicut*** *in partial fulfilment of the requirement for the award of the Degree*

## BACHELOR OF SCIENCE IN ZOOLOGY

BY


| Sl. No. | Name of students in the group | Register No. |
|---|---|---|
| 1 | Chandana Janardhanan | CCAVSZO005 |
| 2 | Lakshmi AP | CCAVSZO008 |
| 3 | Niharika | CCAVSZO010 |
| 4 | Salvador VS | CCAVSZO012 |
| 5 | Abhinav Krishna PV | CCAVSZO013 |
| 6 | Aysha Nedha Sakir | CCAVSZO022 |
| 7 | Mithralmajan PT | CCAVSZO029 |
| 8 | Anjima NC | CCAVSZO035 |
| 9 | Grace Maria Paulson | CCAVSZO036 |

DEPARTMENT OF ZOOLOGY

CHRIST COLLEGE (AUTONOMOUS)
IRINJALAKUDA, THRISSUR, KERALA – 680125


**MARCH 2024**

# CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA
# DEPARTMENT OF ZOOLOGY

## CERTIFICATE

This is to certify that the project work entitled **'A Bioinformatic Study on the Molecular Evolution of Collagenases in Primates'** is an authentic record of research work carried out by **Chandana Janardhanan, Lakshmi AP, Niharika, Salvador VS, Abhinav Krishna PV, Aysha Nedha Sakir, Mithralmajan PT, Anjima NC** and **Grace Maria Paulson** as part of BSc syllabus during the year **2023-2024** and the results of this work has not been presented for the award of any other degree/ diploma in any university.

### Certified bona fide by

**Dr. Leyon Varghese**
Supervising Guide

**Dr Sudhikumar A. V.**
Head, Department of Zoology

Date :

Place :

### Examined by

1. ____________________________

2. ____________________________

# DECLARATION

We, the following students do hereby declare that this project report entitled **'A Bioinformatic Study on the Molecular Evolution of Collagenases in Primates'** is a genuine record of the project work done by us under the guidance of Dr. Leyon Varghese, Assistant Professor, Department of Zoology, Christ College (Autonomous), Irinjalakuda and that this report has not been submitted to any University/Institution for the award of any Degree or Diploma. We further declare that the results presented in this work and considerations made therein, contribute in general to the advancement of knowledge in science and is devoid of any plagiarism.

| Sl. No. | Name of Students | Register No. | Signature |
|---|---|---|---|
| 1 | Chandana Janardhanan | CCAVSZO005 | |
| 2 | Lakshmi AP | CCAVSZO008 | |
| 3 | Niharika | CCAVSZO010 | |
| 4 | Salvador VS | CCAVSZO012 | |
| 5 | Abhinav Krishna PV | CCAVSZO013 | |
| 6 | Aysha Nedha Sakir | CCAVSZO022 | |
| 7 | Mithralmajan PT | CCAVSZO029 | |
| 8 | Anjima NC | CCAVSZO035 | |
| 9 | Grace Maria Paulson | CCAVSZO036 | |

Place : Irinjalakuda

Date : 28-02-2024

## CONTENTS

## INTRODUCTION

The first true primates evolved around 55 million years ago or a bit earlier, near the beginning of the Eocene Epoch. Their fossils have been found in North America, Europe, and Asia. They looked different from the present day primates. Changes in gene regulation and differences in mRNA expression levels across primates have often been documented, however, it is not yet known to what extent measurements of divergence in mRNA levels reflect divergence in protein expression levels, which are probably more important in determining phenotypic differences. Collagenases, a subgroup of Matrix matalloproteases (MMPs) are a large family of zinc-dependent endopeptidases with a great affinity for several components of the extracellular matrix. The collagenases include MMP-1 (interstitial collagenase/collagenase-1), MMP-8 (neutrophil collagenase/collagenase-2), and MMP-13 (collagenase-3). These MMPs attack triple helical regions of interstitial collagen types I, II, and III at a specific single site after the Gly residue of the partial sequences Gly-(Ile or Leu)-(Ala or Leu), located about three-fourths of the distance from the N-terminus. This cleavage generates fragments approximately three-fourths and one-fourth of the size of the collagen molecules. They are distinct from a closely related gelatinases (MMP2 and 9) that are characterized by the presence of the additional fibronectin domain located inside the catalytic domain.

A phylogenetic tree or evolutionary tree is a graphical representation which shows the evolutionary history between a set of species or taxa during a specific time. In other words, it is a branching diagram or a tree showing the evolutionary relationships among various biological species or other entities based upon similarities and differences in their physical or genetic characteristics. In evolutionary biology, all life on Earth is theoretically part of a single phylogenetic tree, indicating common ancestry. Phylogenetics is indeed the study of this phylogenetic tree. The main challenge is to find a phylogenetic tree representing optimal evolutionary ancestry between a set of species or taxa. The first step in the phylogenetic tree construction (using bioinformatics tool) with a new sequence would be to use BLAST. This nifty yet powerful resource matches your sequence to the millions of sequences stored in genomic and nucleotide databases. The tool comes up with the sequences most similar to the query submitted.

It also gives insights as to the possible identity of those sequences. The results include homologues across species and in similar tissues or organisms. A sequence alignment is a way of arranging the sequences of DNA, RNA, or protein to identify regions of similarity that may be a consequence of functional, structural, or evolutionary relationships between the sequences. If two sequences in an alignment, they share a common ancestor and mismatches can be interpreted as point mutations and gaps as indels (that is, insertion or deletion mutations) introduced in one or both lineages in the time since they diverged from one another. In sequence alignments of proteins, the degree of similarity between amino acids occupying a particular position in the sequence can be interpreted as a rough measure of how conserved a particular region or sequence motif is among lineages.

Phylogenetics and sequence alignment are closely related fields due to the shared necessity of evaluating sequence relatedness. The field of phylogenetics makes extensive use of sequence alignments in the construction and interpretation of phylogenetic trees, which are used to classify the evolutionary relationships between homologous genes represented in the genomes of divergent species. The degree to which sequences in a query set differ is qualitatively related to the sequences evolutionary distance from one another. Roughly, high sequence identity suggests that the sequences in question have a comparatively young most recent common ancestor, while low identity suggests that the divergence is more ancient. This approximation, which reflects the “molecular clock” hypothesis that a roughly constant rate of evolutionary change can be used to extrapolate the elapsed time since two genes first diverged , assumes that the effects of mutation and selection are constant across sequence lineages.

**REVIEW OF LITERATURE**

Primates are unique among placental mammals. Two extreme type of placentation are present in this single order. Strepsirrhines have non-invasive epitheliochorial placentation and Haplorhines have highly invasive haemochorial placentation. Strepsirrhines include Lemurs and Lorisiforms and Haplorhines include tarsiers and higher primates. Resemblance in placenta type provide the first evidence that tarsiers are linked to higher primates and distinct from lemurs and lorisiforms. Tree-shrews have endotheliochorial placentation and differ from both primate subgroups. Endotheliochorial placentation is primitive and epitheliochorial placentation is unlikely to be primitive.The recent availability of comprehensive molecular phylogenies for placental mammals has provided an independent framework to determine the most parsimonious interpretation of the evolution of placenta types (Robert Martin, 2008). In an earlier elaborate study, speciation between primates and rodents was estimated by looking at the protein coding genes of mitochondrial genomes from 31 mammals (A.D Yoder 2000). Based on paleontological data, three calibration points were used: one at 20–25 MYA for the hominoid/cercopithecoid divergence, one at 53–57 MYA for the cetacean/artiodactyl divergence, and the third at 110–130 MYA for the metatherian/eutherian divergence. Nulceotide and the amino acid sequence were looked at and results produced that were not mutually exclusive.

Even with decades of data and methods, we still can't agree on the exact evolutionary tree of higher primates (apes and humans). The most likely scenario has humans closest to chimps, but other possibilities exist. Despite numerous theories, 20 key reasons cause this uncertainty. New methods using DNA offer hope for more definitive answers. (Holmquist et al 1988). Primate phylogeny forms a solid framework for a novel depiction of diverse patterns of genome evolution among primate lineages. They are essential for future comparative genomic investigation of adaptation and selection in humans and across primates. Studies on the evolution of catarrhine primates were done using molecular, fossil and bio geographical data. It was found that the common ancestor of Old World Monkeys originated in Africa and some monkeys later moved to Asia around 10 million years ago. The study further suggested that the ancestor of the

living hominids left Africa about 20 mya and the common ancestor of the living African apes returned to Africa from Eurasia around 10 mya (Caro-Beth Stewart, Todd R Disotell 1998).

In the deep study of evolutionary roots of strepsirrhine primate labyrinthine morphology, geometric morphometric analysis showed that the labyrinthine morphology of extant strepsirrhines contains a mixed locomotor, allometric and phylogenetic signal. Discriminant analysis at the family level confirmed that labyrinthine shape is a good taxonomic marker. The results support the hypothesis that evolutionary change in labyrinthine morphology is adequately described with a random walk model, i.e. random phenotypic dispersal in morphospace (Lebrun et al, 2010). An overview of the taxonomy of New World primates based on morphology to the great number of studies based on molecular data aiming for the elucidation of the phylogeny of New World monkeys. The traditional classification of the infraorder Platyrrhini divided these primates into Cebidae and the Callitrichidae, with Callimico being allocated to either the former (Simons, 1972, Simpson, 1945) or the latter family. Hill (1957) and Hershkovitz, 1972, Hershkovitz, 1977 proposed a third family – Callimiconidae – to accommodate Callimico, because it shares characteristics that define both cebids and callitrichids. According to Hershkovitz (1977), then all New World primates should be included in one of three families – the Callitrichidae which comprised the marmosets, tamarins (Saguinus) and lion tamarins (Leontopithecus), the monotypic Callimiconidae (Callimico) and the Cebidae (Schneider et al, 2015).

In a study on molecular phylogeny and evolution of primate mitochondrial DNA, researchers determined nucleotide sequences of homologous 0.9-kb fragments of mitochondrial DNAs (mtDNAs) derived from four species of old-world monkeys, one species of new-world monkeys, and two species of prosimians. With these nucleotide sequences and homologous sequences for five species of hominoids, they constructed a phylogenetic tree for the four groups of primates. The phylogeny obtained is generally consistent with evolutionary trees constructed in previous studies. The results also suggest that the rate of nucleotide substitution for mtDNAs in hominines (human, chimpanzee, and gorilla) have slowed down compared with that for old-world monkeys (Hayasaka, 1988). Mitochondrial genomes have been used to study the

phylogenetic relationship of primates in detail. Using 454 sequencing, the study adds 32 new complete mitochondrial genomes and introduces 20 previously unrepresented genera in the primate tree. The study focuses on the New world monkeys and suborder Strepsirrhini. (Knut Finstermeier, et al 2013). The evolutionary relationships of the number of species within the genus Lepilemur were analysed with the help of a comparative cytogenetic and molecular study. The study involved the complete sequencing of the mitochondrial cytochrome b gene from 68 individuals and the results were compared to those obtained from cytogenetic studies derived from 99 specimens. The results support the classification of the eight major supportive lemur taxa as independent species. (Nicole Andriaholinirina, et al. 2006)

The relationship between the prion protiens and new world primate phylogeny have been studied. The PrP C prion protein contains 250 amino acids with some variation among species and is expressed in several cell types. Variations in the prion protein gene were observed among 16 genera of New World primates (Platyrrhini), and resulted in amino acid substitutions when compared with the human sequence. Schneider et al, 2004)

Beta-globin gene cluster of primates were analyzed to understand their evolutionary history. The rate of accumulation of mutations have also been seen to vary by a factor of 7 among different primate lineages. The study groups superfamilies Lemuroidea and Lorisoidea into suborder Strepsirhini and Tarsius and Anthropoidea into suborder Haplorhini. Evolution rates have been suggested to have slowed down over the past 25 million years of hominoid descent and has found to have happened in correlation with lengthened lifespans (Koop, BF et al 1989).

Using the SINE's methods for the analysis of mobile element based of old world monkeys. It helps to known ancestral staples. Makes them to useful genetic studies for phylogenetic studies. Alu is an helping part of it, in this methods found 285 new Alu Insertions from sixteen old world monkeys. Old world monkeys are  represent on the most diverse and largest primate families. And have  respect classification. The phylogenetic researchers are classified and grouped the old world monkeys into different classes and divisions. Mainly the subfamily  cerocopithecidae  are the most studied group.. SINEs ( short interspersed element are

used as the genetic markers this will helps to analysis several levels of phylogenetic analysis. Using both Compcompuational and PCR methods (Xing a et al, 2005).

New world monkeys represent monophyletic group. The phylogenetic relationships among new world monkeys have been extensively investigated using nucleotide sequence from different genome.In these studies still there are some unresolved issues.There are three monophyletic new world monkey families Atelidae, Cebidae and Pitheciidae. As a result Maximum parsimony analysis support the three proposed platyrrhine families. In the maximum parsimony tree, the two most closely related families are Atelidae and Cebidae.Phylogenetic relationships were reconstructed by maximum parsimony, maximum likelihood, and Bayesian approaches (JuanC Opazo et al, 2006). Anthropoid primates from the neotropics are members of parvorder Platyrrhini. The platyrrhines are also called New World monkeys. There are more than 125 species of extant New World monkeys found in approximately 15 genera. The phylogenetic relationships of these neotropical primates have been extensively studied from a molecular perspective (Derek wildman et al, 2009).

Phylogenetic trees are certainly useful for comparative studies, providing a useful framework for comparative biologists. Species evolution is not statistically independent. The fact that close relatives inherit characteristics from their common ancestor has always complicated the analysis of cross- species data. The methods in turn developed to resolve such issues, all requires resolved phylogeny. In one of the earlier studies, primates phylogeny was estimated of all 203 species of primates. Application of parsimony algorithm and bootstrapping resulted in the composite tree with 160 nodes (Purvis, Andy 1995).

In a project conducted under the support from National Cancer Institute and National Institute of Health, researchers constructed a robust phylogenetic tree of primates. The tree was constructed from the data collected of genomic sequences from 186 primates. Also outgroup species from Dermoptera, Scandentia and Lagomorpha was included. This phylogenetic representation done carefully was a notable illumination showing the pathway of primates evolution (Perelman et.al 2011).

Studies also estimated the molecular divergence dates of major primates in the context of molecular clock studies. Such studies also aid in understanding the lineage. Utilizing the genomic data, molecular divergence dates were able to be studied since alignments can be arranged and sites can be analysed for this study. Much before the molecular clock, paleontology used to provide only a mere timeframe of species evolution (Steiper et.al. 2006).

Inferring molecular phylogeny for evolutionary studies are done in non- primates as well. The molecular phylogeny of malarial parasites was recovered from mitochondrial cytochrome b gene sequences. Parsimony as well as maximum- likelihood analysis produced similar phylogenetic trees in this case. The conclusions were supported by hypothesis testing (Perkins et.al 2002). Inferring species super matrix has helped in studying macroevolutionary dynamics and even historical biogeography. The results obtained highlighted both the power as well as limitations of inferring the molecular phylogeny data to different species concepts (Springer et.al. 2012).

Over the past 60 million years, a million copies of Alu DNA have appeared in the genomes of primates. This is still an ongoing process. DNA alu repeats in the genomes of primates such as human, chimpanzee, gorilla, orangutan, baboon, rhesus, and macaque. New Alu elements arise in unique and irreversible events and appear to prevent precise excision and loss. The same insertions cannot occur independently in two species. Once the insert is genetically fixed, the DNA elements persist in all descendant lineages. Different from point mutation, the distribution of individual alu corresponds to a phylogeny only (H. Hamdi, 1999).

To resolve the debate in strepsirrhine phylogeny, 61 loci containing interspersed elements were characterized and the absence and presence of orthologous loci in the strepsirrhine panel was determined. According to these findings, it is concluded that strepsirrhines originated in Africa, and that Madagascar and Asia were colonized by immigration events (C. Roos, 2004). To investigate the phylogenetic relationships among species of New World monkeys, 1.3 kb of DNA was collected for 2 introns of the glucose-6-phosphate dehydrogenase locus encoded on the x chromosome of 24 species of New World monkeys (M. Von. Dornum, 1999).

Two molecular based approaches are used to date the initial divergence of the platyrrhine clade, a relaxed clock model using fossil record and genome datasets, and Bayesian inferences from generation time and body size to substitution rate. Fossil constraints, topology, and substitution rate are an important part of our divergence time estimates.  making an impact. Bayesian estimates using conservative and realistic fossil constraints suggest that the LCA of extant platyrrhines is 29 Ma, with a 95% confidence interval for Nodine of 27–31 Ma (SI Perez, 2013). The sequences of nuclear protein-coding gene LCAT were used to study the relationship between 19 extant rodents. The study agrees with several previous molecular and morphological studies, both concerning branching orders inside Muroidea and the bush-like radiation of rodent suprafamilial taxa. This indicates that this nuclear gene is a fitting candidate for tackling questions about rodents relationships.

The data from primates were used to reveal that the molecular clock in CpG and non-CpG sites have different nature, projecting differences in their molecular origin. Through the process, it was observed that molecular clocks are heterogeneous even within a genome. During phylogenetic analysis and while concluding divergence times using molecular data, one should be mindful that different regions of genome follow different  molecular clocks. In this study, our efforts are directed towards studying the pathway of certain collagenases in the course of evolution. Even though  some studies have been done using DNA sequences and that too in different context, in our study we focusses primarily on amino acid sequences. This is not a well researched area. Though this study we aim on providing a new work in the area of comparative biology. The results of the work may be useful in the future providing insights into how may be the few crucial changes in amino acids may have resulted into a complete new lineage.

## SIGNIFICANCE OF THE STUDY

The study of molecular evolution in primates through the comparison of amino acid sequences using bioinformatics tools represents a novel and underexplored area of research. To date, there has been a notable scarcity of studies employing bioinformatics techniques to investigate the evolutionary patterns of primates, particularly in relation to proteins such as MMP1, MMP8 and MMP13 collagenases. The selection of these collagenases for our study is particularly significant due to their split genes nature. By conducting a comparative analysis of the evolutionary trees derived from the collagenases with established standard trees, we aimed to shed light on the distinctive evolutionary trajectories of these proteins in primates. The insights obtained from this comparative study have the potential to deepen our understanding of the molecular evolution of primates and elucidate the factors driving the evolution of collagenases in this taxonomic group.

**OBJECTIVES**

1. Retrieval of relevant data (Gene/mRNA/protein sequence of collagenases of primates) from relevant reliable resources such as NIH or SIB.

2. Align the retrieved sequences using bioinformatics software to ensure they are in the correct reading frame and homologous positions are appropriately aligned.

3. Construction of the phylogenetic trees based on the Gene/mRNA/protein sequence of collagenases in primates.

## METHODOLOGY

The three human collagenases used in the study are MMP1, MMP8 and MMP13. The FASTA sequence and other details of collagenases are as below.

```
>NP_002412.1 interstitial collagenase isoform 1 MMP1 UniProt_P03956 [Homo sapiens]
MHSFPPLLLLLFWGVVSHSFPATLETQEQDVDLVQKYLEKYYNLKNDGRQVEKRRNSGPVVEKLKQMQEF
FGLKVTGKPDAETLKVMKQPRCGVPDVAQFVLTEGNPRWEQTHLTYRIENYTPDLPRADVDHAIEKAFQL
WSNVTPLTFTKVSEGQADIMISFVRGDHRDNSPFDGPGGNLAHAFQPGPGIGGDAHFDEDERWTNNFREY
NLHRVAAHELGHSLGLSHSTDIGALMYPSYTFSGDVQLAQDDIDGIQAIYGRSQNPVQPIGPQTPKACDS
KLTFDAITTIRGEVMFFKDRFYMRTNPFYPEVELNFISVFWPQLPNGLEAAYEFADRDEVRFFKGNKYWA
VQGQNVLHGYPKDIYSSFGFPRTVKHIDAALSEENTGKTYFFVANKYWRYDEYKRSMDPGYPKMIAHDFP
GIGHKVDAVFMKDGFFYFFHGTRQYKFDPKTKRILTLQKANSWFNCRKN

>NP_002415.1 neutrophil collagenase isoform 1 MMP8 UniProt_P22894 [Homo sapiens]
MFSLKTLPFLLLLHVQISKAFPVSSKEKNTKTVQDYLEKFYQLPSNQYQSTRKNGTNVIVEKLKEMQRFF
GLNVTGKPNEETLDMMKKPRCGVPDSGGFMLTPGNPKWERTNLTYRIRNYTPQLSEAEVERAIKDAFELW
SVASPLIFTRISQGEADINIAFYQRDHGDNSPFDGPNGILAHAFQPGQGIGGDAHFDAEETWTNTSANYN
LFLVAAHEFGHSLGLAHSSDPGALMYPNYAFRETSNYSLPQDDIDGIQAIYGLSSNPIQPTGPSTPKPCD
PSLTFDAITTLRGEILFFKDRYFWRRHPQLQRVEMNFISLFWPSLPTGIQAAYEDFDRDLIFLFKGNQYW
ALSGYDILQGYPKDISNYGFPSSVQAIDAAVFYRSKTYFFVNDQFWRYDNQRQFMEPGYPKSISGAFPGI
ESKVDAVFQQEHFFHVFSGPRYYAFDLIAQRVTRVARGNKWLNCRYG

>NP_002418.1 collagenase 3 MMP13 UniProt_P45452 [Homo sapiens]
MHPGVLAAFLFLSWTHCRALPLPSGGDEDDLSEEDLQFAERYLRSYYHPTNLAGILKENAASSMTERLRE
MQSFFGLEVTGKLDDNTLDVMKKPRCGVPDVGEYNVFPRTLKWSKMNLTYRIVNYTPDMTHSEVEKAFKK
AFKVWSDVTPLNFTRLHDGIADIMISFGIKEHGDFYPFDGPSGLLAHAFPPGPNYGGDAHFDDDETWTSS
SKGYNLFLVAAHEFGHSLGLDHSKDPGALMFPIYTYTGKSHFMLPDDDVQGIQSLYGPGDEDPNPKHPKT
PDKCDPSLSLDAITSLRGETMIFKDRFFWRLHPQQVDAELFLTKSFWPELPNRIDAAYEHPSHDLIFIFR
GRKFWALNGYDILEGYPKKISELGLPKEVKKISAAVHFEDTGKTLLFSGNQVWRYDDTNHIMDKDYPRLI
EEDFPGIGDKVDAVYEKNGYIYFFNGPIQFEYSIWSNRIVRVMPANSILWC
```

The study on phylogenetic relationships in primates was conducted using this amino acid sequences to do the BLAST (Basic Local Alignment Search Tool) analysis in the NCBI Genebank database. The most suitable amino acid sequences for each primate species were then carefully selected from sequences delivered by the server. An out group was chosen which in our study was the Mus musculus of the order Rodentia.

The selected sequences were then compared with that of the out group and a phylogenetic tree was constructed based on the degree of divergence. The software used for constructing phylogenetic tree was  Molecular Evolutionary Genetics Analysis (MEGA).

## RESULTS AND DISCUSSIONS

The research article titled “A Molecular Phylogeny of Living Primates” published in 2011, established a robust and widely accepted framework for understanding primate evolution. This phylogenetic tree served as a standard reference for our study, allowing us to compare our data and draw conclusions. According to this article Order Primata is subdivided into two major Suborder Haplorrhini and Strepsirrhini. The remaining primate phylogeny is classified as follows.

**Suborder Haplorrhini** further divides into Infraorders, namely Simiiformes and Tarsiiformes. Tarsiiforme include only one Family (Tarsiidae) with only two extant species. Simiiformes is subdivided into Parvorders Catarrhini (Old world) and Platyrrhini (New world).

Parvorder Catarrhini in turn consist of the Superfamilies Cercopithecoidea and Hominoidea. Cercopithecoidea has only one extant Family *viz*. Cercopithecidae but the organisms of Superfamily Hominoidea is further divided into two Families, *viz*, Hylobatidae and Hominidae. Family Cercopithecidae has two Subfamilies such as Cercopithecinae and Colobinae. Family Hylobatidae include all Gibbon Genus and there is no further subgrouping. Hominidae on the other hand has two Subfamilies *viz.* Homininae and Ponginae. Subfamily Ponginae include all species of Orangutang and all o there Greater Apes and Humans are included in Homininae. Subfamily Cercopithecinae is subdivided into two Tribes namely, Papionini and Cercopithecini whereas Colobinae is subdivided into two Tribes namely Presbytini and Colobini.

Parvorders Platyrrhini on the other hand is divided directly into three Families such as Cebidae, Atelidae and Pitheciidae. Family Cebidae has four Subfamilies namely, Callitrichinae, Aotinae, Cebinae and Saimirinae. Fly. Atelidae has two Subfamilies (Atelinae & Alouattinae) so also Fly. Pitheciidae (Callicebinae & Pitheciinae).

**Suborder Strepsirrhini** is divided into the Infraorders Lemuriformes, Chiromyiformes and Lorisiformes. Unlike Haplorrhini, there is no observed grouping of these Infraorders into Parvorders or Superfamilies. Instead, they are grouped into Families such as Lepilemuride,

Cheirogaleidae, Indriidae, Lemuridae, Daubentoniidae, Lorisidae and Galagidae. Further subdivision within Lorisidae includes the subfamilies Lorisinae and Perodicticinae.

**MMP-1**

The phylogenetic tree for the MMP1 gene in primates was meticulously constructed, employing an analysis of amino acid sequences from various primate species. To enhance our phylogenetic analysis, *Mus musculus* was strategically employed as the outgroup, providing a reference point for the evolutionary relationships within the MMP1 collagenase gene among primates. Our investigation also utilized a well established standard phylogenetic tree for primates, derived from genomic sequences across diverse species, serving as a foundational reference for elucidating the evolutionary dynamics of collagenase genes within our study group (Reference). The results obtained regarding the evolutionary pathway of the MMP1 gene include the following observations:

- *Carlito syrichta*: Our findings indicate that MMP1 gene of *Carlito syrichta,* a tarsier species primarily descended with minimal changes from the common ancestor of all primates indicating an ancient ancestry. Although this tree suggests such an ancient ancestry and early divergence of *Carlito syrichta* from the early primate stock, a comparison with the established tree reveals that tarsiers diverged from a common stock of strepsirrhini - more primitive primate. It is therefore inferred that the MMP1 gene remained with minimum changes in the tarsiers as compared to strepsirrhini primates.

- *Hominidae:* In our tree constructed using MMP1 the common ancestor of *Pan* and *Homo*, along with the common ancestor of *Gorilla* and *Pongo,* collectively share a common ancestor. Gibbons, including *Nomascus* and *Symphalangus,* share a common ancestor that along with the common ancestor of *Hominidae* were descended from a common stock of interbreeding ape like animal. Upon analysing the standard phylogenetic tree, a similar pattern emerges, with *Homo* and *Pan* sharing a common ancestor. This common ancestor was also ancestral to present day *Gorilla,* from which the *Pongo* ancestry might have diverged. However, the discrepancy in our results suggestive of *Gorilla* sharing a recent

common ancestor with *Pongo,* but not with *Homo* or *Pan*. This suggests a simultaneous origin for *Gorilla* and *Pongo*, contrary to the standard tree's assertion of *Gorilla*'s more recent evolution compared to *Pongo*. Further analysis of the amino acid sequences are required to see if the *Homo-Pan* group has any common advantage with the kind of changes on the MMP1 protein over the *Gorilla-Pongo* group.

- Old World Monkeys: Our results indicate that, three groups *viz. Macaca*, *Papio* and *Theropithecus* are equally distant from a common ancestor, while *Colobus* and *Trachypithecus* share another common ancestor. The standard phylogenetic tree confirms this, revealing a common ancestor for *Colobus* and *Trachypithecus,* along with the ancestor of *Macaca, Papio* and *Theropithecus.* But with *Macaca, Papio* and *Theropithecus,* our results differ from the standard tree. While standard tree implies that *Papio* and *Theropithecus* had a common ancestor after the common ancestry shared with *Macaca,* our tree do not mention between an ancestor common to both *Papio* and *Theropithecus.* Though the changes are minimal, it wold be interesting to look for the their sequences for further analysis.

- New World Monkeys: Our findings in New World Monkeys suggest that *Saimiri* and *Cebus* share a most recent common ancestor, while *Aotus* share a common ancestor with this lineage. This is consistent with both our phylogenetic tree and the standards phylogenetic tree. Furthermore, *Nycticebus* and *Otolemur* share a common ancestor, and *Lemur* and *Microcebus* also share a common ancestor. The common ancestors of these pairs collectively had a single common ancestor, aligning with observations on the standard phylogenetic tree.

**MMP-8**

- *Hominidae*: In the phylogenetic tree derived from MMP8 sequence data, it was observed that the common ancestor of Homo and Gorilla shares ancestry with the common ancestor of Pan. This collective ancestry is further linked to the common ancestor of Hominidae, which is shared with Gibbons. In contrast to the standard phylogenetic tree, where Pan and Homo share an ancestor ancestral to present-day Gorilla, our results suggest the potential existence of an alternative evolutionary pathway for these three species. A comprehensive investigation is recommended to explore the implications of this alternative pathway further.

- Loris: Our findings indicate that the Loris shares a common ancestor with Hominidae, Tarsier, Gibbons, New World, and Old World monkeys, all of which originate from the Strepsirrhini primates. Similarly, Lemurs are shown to arise from Haplorrhini primates. Discrepancies with the standard phylogenetic tree, which suggests a more recent common ancestry for Lemurs and Loris, necessitate further analysis to validate the proposed ancestral pattern among the descendants of these two major groups of early primates.

- New World Monkeys: Upon examining the lineage of New World monkeys, it is observed that recent descendants Aotus and Saimiri share a common ancestor, which is further linked to the common ancestor of Cebus and Sapajus. This lineage can be traced back to early Strepsirrhini primates. Although minor differences are noted compared to the standard phylogenetic tree, where an ancestor common to Saimiri and Cebus precedes the common ancestry with Aotus, further analysis is warranted to explore these nuances.

- Old World Monkeys: Our analysis reveals that Papio and Theropithecus share a common ancestor, which is connected to the common ancestor of Macaca. This ancestral lineage can be traced back to an ancestor shared with the common ancestor of Piliocolobus and Trachypithecus. The observed pattern aligns with the standard phylogenetic tree in the lineage of Old World monkeys.

**MMP-13**

- *Hominidae*: When we comparing the phylogenetic tree made by us on the basis of MMP13 and the standard one, the Nomascus leucogenys & Symphalongus syndactylus (Hylobatidae) share a recent common ancestor and they together share common ancestor with old world monkeys in MMP13. But, when we comparing this with the standard one we can observe that the Hylobatidae sharing common ancestor with Hominidae.

- New World Monkeys: Our findings in new world monkeys by comparing the Standard phylogenetic tree with the phylogenetic tree of MMP13 depicting that, in the phylogenetic tree of MMP13, the Cebus imitator & Sapajus apella shares a recent common ancestor and these group share a common ancestor with Samiri bolivensis and all of these collectively share a common ancestor with Aotus nancymaae. When we comparing this with the standard phylogenetic tree Cebus imitator & Samiri bolivensis directly arrived from a common ancestor.

- Old World Monkeys: By analysing the group Cercopithecidae in the tree of MMP13, Papio Anubis & Theropithecis gelada share a recent common ancestor and they together share a common ancestor with Macaca group, Piliocolobus tephrosceles & Trachypithecus francoisi directly. But when we comparing this with the standard phylogenetic tree, they where not sharing a common ancestor directly, all of them share a common ancestor with other species recently, but all of them primitively share a common ancestor.

```
Alignment: D:\Leyon\Evolution\MMP1\1-tree_for_seaview.txt
Seaview [blocks=10 fontsize=12 A4-landscape] on Wed Jan 31 07:26:41 2024

                              1
Homo_sapiens                  MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Mus_musculus                  MPSLP---LL LLLWAASSYS FPVFHNGDRQ NVETVWKYLE NYYNL---GK NMQAKNVNGK EMMAEKLRQM
Aotus_nancymaae               MHSYPP-LLL LLFWGVVSHG FPATLETQEQ DVEIVQKYLE QYYNLKNDGK QVEKKRSSGP --VVEKLKQM
Carlito_syrichta              MPSLP--LVL MLLWAVGSRG FPATSETREQ DVEIVQKYLE NYFNLKNDGK QFEKQRHSAP --VVEKLKEM
Cebus_imitator                MHSYPL-LLL LLFWGVVSHG FPATLETQEQ DVEIVQKYLE QYYNLKNDGK QVEKQRNSGP --VVEKLKQM
Gorilla_gorilla               MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Lemur_catta                   MPSFS--LLL LLLWGLGSHG FPAIPETQEQ DVEIVQKYLE NYYDLKNVGK QIEKKRSSGS --VVEKLKQM
Macaca_mulatta                MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDFVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Macaca_nemestrina             MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Microcebus_murinus            MPRFS--LLL LLLWSLGSHG LPVAPETQEQ DVEIVQKYLE NYYDLKNDGK QIEKKRNSGP --VVEKLKQM
Nomascus_leucogenys           MHSFPPLLLL LLFWSVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGL --VVEKLKQM
Nycticebus_coucang            MPSF---LLL LLLWGLGSHA FPAIPEPQEQ DVEIVQKYLE NYYDLKNDGS QIERKRNSGP --VVEKLKQM
Otolemur_garnettii            MSSFP--LLL LLLWGLGSHA LPVTPETQEQ DVEIVQKYLE NYYDLKNDGM QIERKRNSGP --VVEKLKQM
Pan_paniscus                  MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Pan_troglodytes               MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Papio_anubis                  MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Piliocolobus_tephrosceles     MHSFPPLLLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVQKQRNSGP --VVEKLKQM
Pongo_abelii                  MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Pongo_pygmaeus                MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Saimiri_boliviensis           MHSYPP-LLL LLFWSVVSHG FPATLETQEQ DVEIVQKYLE QYYDLKNDGK QVEKQRNSGP --VVEKLKQM
Sapajus_apella                MHSYPL-LLL LLFWGVVSHG FPATLETQEQ DVEIVQKYLE QYYNLKNDGK QVEKQRNSGP --VVEKLKQM
Symphalangus_syndactylus      MHSFPPLLLL LLFWSVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGL --VVEKLKQM
Theropithecus_gelada          MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Trachypithecus_francoisi      MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDRR QVEKQRNSGP --VVEKLKQM
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                             71
Homo_sapiens                 QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Mus_musculus                 QQLFGLKVTG NSDPETLRAM KKPRCGVPDV APYAITHNNP RWTKTHLTYS ILNYTPYLPK AVVEDAIARA
Aotus_nancymaae              QEFFGLKVTG KPDAETLNVM KQPRCGVPDV ARFVLTEGNP RWEKTHLTYR IENYTPDLPR ADVDQAIEKA
Carlito_syrichta             QKFFGLKVTG KPDPETLKVM KQPRCGVPDV AQFVLTEGNP RWQKTDLTYR IENYTPDLPK AEVDRAIEKA
Cebus_imitator               QEFFGLKVTG KPDAETLKVM KQPRCGVPDV ARFVLTEGNP RWKKTHLTYR IENYTPDLPR SDVDHAIEKA
Gorilla_gorilla              QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Lemur_catta                  QEFFGLKVTG KPDTETLKVM KQPRCGVPDV ARFVLTQGNP RWEQTHLTYR IENYTPDLPR ADVDLAIEKA
Macaca_mulatta               QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR AAVDQAIEKA
Macaca_nemestrina            QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR AAVDQAIEKG
Microcebus_murinus           QEFFGLKVTG KPDTETLKVM KQPRCGVPDV ARFVLTQGNP RWEKTHLTYR IENYTPDLSR ADVDHAIEKA
Nomascus_leucogenys          QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTAGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Nycticebus_coucang           QEFFGLKVTG TPDTETLKVM KQPRCGVPDV ARFALTPGNP RWEQTHLTYR IENYTPDLPR ADVDDAIEKA
Otolemur_garnettii           QEFFGLKVTG TPDTETLKVM KQPRCGVPDV ARFVLTQGNP RWEQTHLTYR IENYTPDLPK ADVDDAIEKA
Pan_paniscus                 QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIAKA
Pan_troglodytes              QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIAKA
Papio_anubis                 QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR AAVDQAIEKA
Piliocolobus_tephrosceles    QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDRAIEKA
Pongo_abelii                 QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Pongo_pygmaeus               QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Saimiri_boliviensis          QEFFGLKVTG KPDAETLNVM KQARCGVPDV ARFVLTEGNP RWEKTHLTYR IENYTPDLRR ADVDHAIEKA
Sapajus_apella               QEFFGLKVTG KPDAETLKVM KQPRCGVPDV ARFVLTEGNP RWEKTHLTYR IENYTPDLPR SDVDHAIEKA
Symphalangus_syndactylus     QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTAGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Theropithecus_gelada         QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR AAVDQAIEKA
Trachypithecus_francoisi     QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDRAIEKA
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Homo_sapiens                 FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Mus_musculus                 FRVWSDVTPL TFQRVFEEEG DIVLSFHRGD HGDNNPFDGP NYKLAHTFQP GPGLGGDVHY DLDETWTNSS
Aotus_nancymaae              FQLWSNVTPL TFTKVPKGQA DIMISFVRGD HQDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDETWTNNF
Carlito_syrichta             FQLWSNASPL RFTKVVEGQA DIMISFVRGD HQDNSPFYGP GENLAHAFQP GPNIGGDAHF DEDETWTNNI
Cebus_imitator               FQLWSNVTPL TFTKVPKGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GSGIGGDAHF DEDETWTNNF
Gorilla_gorilla              FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Lemur_catta                  FQLWSNASPL TFTKVFEGQA DIMISFVRGD HQDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDEQWTSDS
Macaca_mulatta               FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Macaca_nemestrina            FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Microcebus_murinus           FQLWSNASPL TFTRVFEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDEQWTNNF
Nomascus_leucogenys          FKLWSNVTPL TFTKVSEGQA DIMISFVRGD HQDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Nycticebus_coucang           FRLWSNASPL TFTKVFQGQA DIMISFVRGD HQDNSPFDGP GGNLAHAFQP GPGIGGDTHF DEDERWTNNL
Otolemur_garnettii           FQLWSNASPL TFTKVFQGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDEKWTNNL
Pan_paniscus                 FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Pan_troglodytes              FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Papio_anubis                 FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Piliocolobus_tephrosceles    FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Pongo_abelii                 FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Pongo_pygmaeus               FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Saimiri_boliviensis          FQLWSNVTPL TFTKVPKGQA DIMISFVRGD HQDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDETWTNNF
Sapajus_apella               FQLWSNVTPL TFTKVPKGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDETWTNNF
Symphalangus_syndactylus     FKLWSDVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DDDERWTNNF
Theropithecus_gelada         FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Trachypithecus_francoisi     FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
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Homo_sapiens                  REYNLHRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Mus_musculus                  ENFNLFYVTA HELGHSLGLT HSSDIGALMF PSYTWYTEDF VLNQDDINRI QDLYGPSPNP IQPTGATTPH
Aotus_nancymaae               REYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGKSQNP VQPTGPQTPQ
Carlito_syrichta              QNYNLYRVAA HEFGHSLGLS HSTDIGALMY PTYT-YSGDV QLAQDDIDGI QAIYGPSQNP IQPTGPQTPQ
Cebus_imitator                RGYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGQSPNP VQPTGPQTPQ
Gorilla_gorilla               REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Lemur_catta                   RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYT-FSGDV QLAQDDIDGI QAIYGPSQNP NQPTGPQTPQ
Macaca_mulatta                REYNLYRVAA HEFGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Macaca_nemestrina             REYNLYRVAA HELGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Microcebus_murinus            RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYA-FSGDV QLAQDDIDGI QAIYGPSQNP NQPIGPQTPQ
Nomascus_leucogenys           REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Nycticebus_coucang            RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYA-FSGEV ELAQDDIDGI QAIYGPSQNP IQPIGPQTPQ
Otolemur_garnettii            RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYA-FSGEV ELAQDDIDGI QAIYGPSQNP VQPTGPQTPQ
Pan_paniscus                  REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGHSQNP VQPIGPQTPK
Pan_troglodytes               REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Papio_anubis                  REYNLYRVAA HELGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Piliocolobus_tephrosceles     REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLSQDDIDGI QAIYGGSQNP VQPTGPQTPK
Pongo_abelii                  REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGPSQNP VQPIGPQTPK
Pongo_pygmaeus                REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGPSQNP VQPIGPQTPK
Saimiri_boliviensis           REYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGPSPNP VQPTGPQTPQ
Sapajus_apella                REYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGQSPNP VQPTGPQTPQ
Symphalangus_syndactylus      REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Theropithecus_gelada          REYNLYRVAA HELGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Trachypithecus_francoisi      REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
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                            281
Homo_sapiens                ACDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Mus_musculus                PCNGDLTFDA ITTFRGEVFF FKGRFYIRVN RFMPEPELNL IGILWPNLPV KLDAAYEASM IDQVRYFKGS
Aotus_nancymaae             VCDSKLTFDA ITTIRGEVFF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Carlito_syrichta            ACDSKISFDA VTTIRGEVMF FKDRFFMRTH PSYPEADLNF ISDFWPLLPN GLEAAYEDAG RDQVRFFKGY
Cebus_imitator              VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PYYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Gorilla_gorilla             VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLQAAYEFAD RDEVRFFKGN
Lemur_catta                 VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPS GLEAAYEVAS RDEVRFFKGN
Macaca_mulatta              VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Macaca_nemestrina           VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Microcebus_murinus          VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF VSVFWPQLPT GLEAAYEVAD RDEVRFFKGN
Nomascus_leucogenys         VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Nycticebus_coucang          VCDSKLTFDA VTTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPS GLEAAYEVVD RDEIRFFKGN
Otolemur_garnettii          VCDSKLTFDA VTTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEVAD RDEVRFFKGN
Pan_paniscus                VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PSYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Pan_troglodytes             VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Papio_anubis                VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Piliocolobus_tephrosceles   VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLQAAYEFAE RDEVRFFKGN
Pongo_abelii                VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Pongo_pygmaeus              VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Saimiri_boliviensis         VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Sapajus_apella              VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PYYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Symphalangus_syndactylus    VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGK
Theropithecus_gelada        VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Trachypithecus_francoisi    VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLQAAYEFAD RDEVRFFKGN
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351

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|---|---|---|---|---|---|---|---|
| Homo_sapiens | KYWAVQGQNV | LHGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVANK | YWRYDEYKRS | MDPGYPKMIA |
| Mus_musculus | KVWAVQEQSV | LRGFPRDIHS | FFGFPSNVTH | IDAAVCEEET | GKTYFFVDHM | YWRYDENTQS | MDPGYPRLTA |
| Aotus_nancymaae | KYWAAQGQNV | LHGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVGNK | YWRYDEYKRS | MDAGYPKMIA |
| Carlito_syrichta | RFWAVQGQDV | LRGYPQDIYS | SYGFPRTVKH | IDAAVFEEET | GKTFFFVGNK | YWRYDEYKRS | MDVGYPKMIA |
| Cebus_imitator | KYWAVQGQNV | LYGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVGNK | YWRYDEYKRS | MDAGYPKKIA |
| Gorilla_gorilla | KYWAVQGQNM | LHGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVGNK | YWRYDEYKRS | MDPGYPKMIA |
| Lemur_catta | KYWAVQGQNV | LPGYPKDIYR | SFGFPRTVKH | IDAAISEEDT | GKTYFFVANK | YWRYDEYKQS | MDTGYPKKLA |
| Macaca_mulatta | KYWAVQGQNV | LPGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVANK | YWRYDEYKRS | MDPGYPKMIA |
| Macaca_nemestrina | KYWAVQGQNV | LPGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVANK | YWRYDEYKRS | MDPGYPKMIA |
| Microcebus_murinus | KYWAVQGQNV | LPGYPKDIYK | SFGFPKTVKH | IDAAVSEEDT | GKTYFFVANK | YWRYDEYKQS | MDAGYPKMIA |
| Nomascus_leucogenys | KYWAVQGQNV | LHGYPKDIYS | SFGFPRTVKR | INAALSEENT | GKTYFFVAKK | YWRYDEYKRS | MDPGYPKMIA |
| Nycticebus_coucang | KYWAVRGQDV | LHGYPKDISS | SFGFPRTVKH | VDAAVSEEET | GKTYFFVANK | YWRYDENKQS | MDTGYPKMIA |
| Otolemur_garnettii | KYWAVRGPDV | LHGYPKDISS | SFGFPRTVKH | VDAAVSEEET | GKTYFFVANK | YWRYDENKQS | MDTGYPKTIA |
| Pan_paniscus | KYWAVQGQNV | LHGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVANK | YWRYDEYKRS | MDPGYPKMIA |
| Pan_troglodytes | KYWAVQGQNV | LHGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVANK | YWRYDEYKRS | MDPGYPKMIA |
| Papio_anubis | KYWAVQGQNV | LPGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVANK | YWRYDEYKRS | MDPGYPKMIS |
| Piliocolobus_tephrosceles | KYWAVQGQNV | LRGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVANK | YWRYDEYKRS | MDPGYPKMIA |
| Pongo_abelii | KYWAVQGQNM | LHGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVANK | YWRYDEHKRS | MDPGYPKMIA |
| Pongo_pygmaeus | KYWAVQGQNV | LHGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVANK | YWRYDEYKRS | MDPGYPKMIA |
| Saimiri_boliviensis | KYWAVQGQNV | LYGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVGNK | YWRYDEYKRS | MDAGYPKMIA |
| Sapajus_apella | KYWAVQGQNV | LYGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVGNK | YWRYDEYKRS | MDAGYPKKIA |
| Symphalangus_syndactylus | KYWAVQGQNV | LHGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVAKK | YWRYDEYKRS | MDPGYPKMIA |
| Theropithecus_gelada | KYWAVQGQNV | LPGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVANK | CWRYDEYKRS | MDPGYPKMIA |
| Trachypithecus_francoisi | KYWAVQGQNV | LRGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVANK | YWRYDEYERS | MDPGYPKMIA |

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Homo_sapiens                  HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Mus_musculus                  EDFPGIDDKV DDVFQKGENF YFFHQSVQHR FNLQIRRVDD SRDSSTWFNC ---
Aotus_nancymaae               DDFPGIGHKV DAVFMKDGFF YFFHKTRQYK FEPETKRILT LQKANSWFNC RKN
Carlito_syrichta              HGFPGIGHKV DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKN
Cebus_imitator                HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Gorilla_gorilla               HDFPGIGHKV DAVFMKDGFF YFFRGRRQYK FDPETKRILT LQKANSWFNC RKN
Lemur_catta                   LDFPGIGHKI DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKK
Macaca_mulatta                HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Macaca_nemestrina             HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Microcebus_murinus            HDFPGIGHKI DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKN
Nomascus_leucogenys           HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Nycticebus_coucang            HDFPGIGHKV DAVFKKDEFF YFFHGTRQYK FDLKTKRILT LLKANSWFNC RKH
Otolemur_garnettii            HDFPGIGHKV DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKH
Pan_paniscus                  HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Pan_troglodytes               HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Papio_anubis                  HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Piliocolobus_tephrosceles     HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Pongo_abelii                  HDFPGIGHKV DAVFTKDGFF YFFHGTRQYK FDPETKRILT LQKANSWFNC RKN
Pongo_pygmaeus                HDFPGIGHKV DAVFTKDGFF YFFHGTRQYK FDPETKRILT LQKANSWFNC RKN
Saimiri_boliviensis           HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Sapajus_apella                HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Symphalangus_syndactylus      HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Theropithecus_gelada          HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Trachypithecus_francoisi      HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
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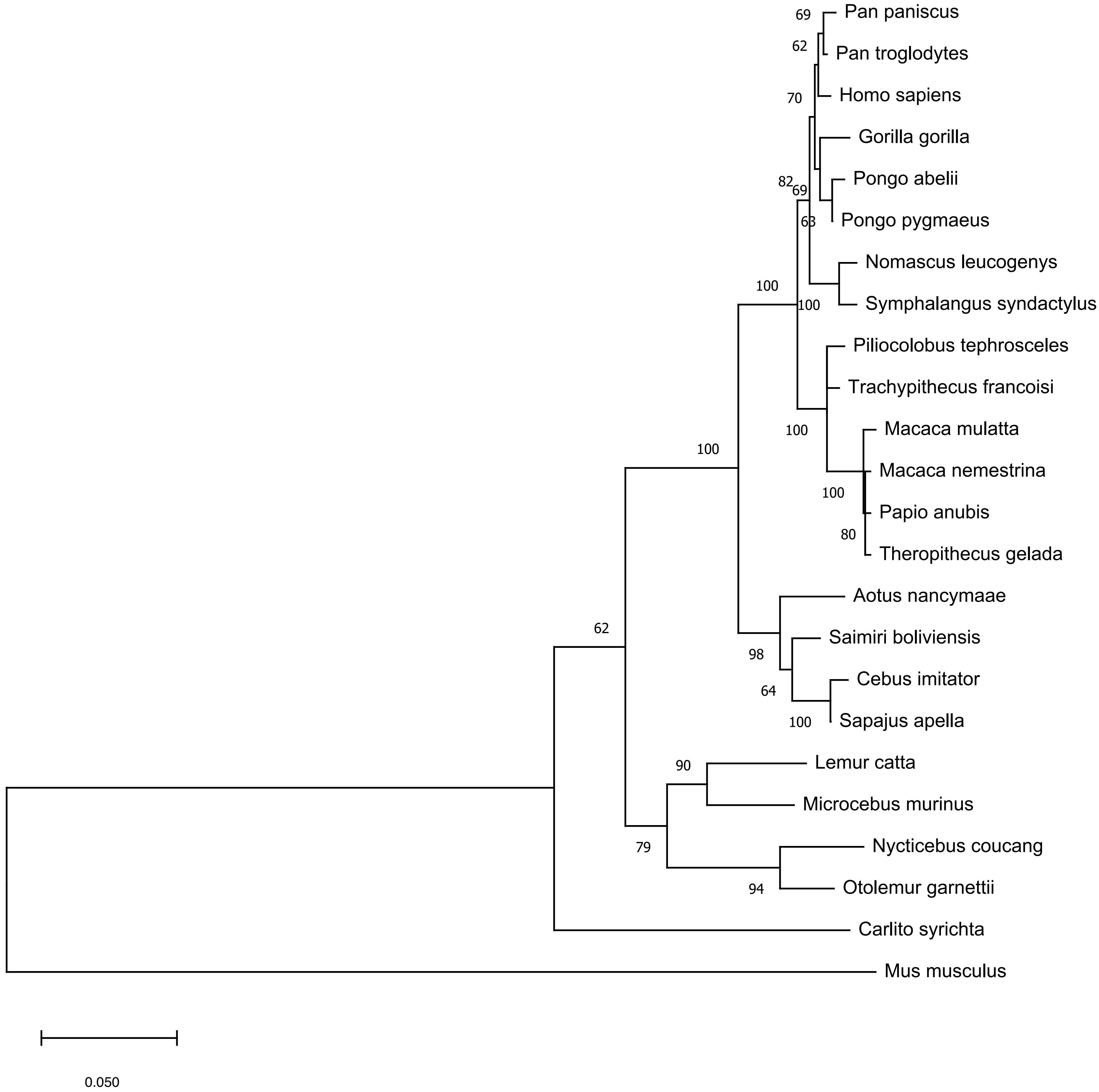
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Pan troglodytes
Homo sapiens
Gorilla gorilla
Pongo abelii
Pongo pygmaeus
Nomascus leucogenys
Symphalangus syndactylus
Piliocolobus tephrosceles
Trachypithecus francoisi
Macaca mulatta
Macaca nemestrina
Papio anubis
Theropithecus gelada
Aotus nancymaae
Saimiri boliviensis
Cebus imitator
Sapajus apella
Lemur catta
Microcebus murinus
Nycticebus coucang
Otolemur garnettii
Carlito syrichta
Mus musculus
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Mus_musculus                  MFRLKTLPLL IFLHTQLANA FPVPEHLEEK NIKTAE---- -------NYLR KFYNLPSNQF RSSRN--ATM
Aotus_nancymaae               MFCLKTLPFL LLLHVQISKA FPVSS--KEK DTKIVQ---- -------DYLE KFYQLPSNQY QSIRKNSINM
Carlito_syrichta              MFSLQMLLFL LLLHMQVATA FPTPS--EEK STTMVQ---- -------DYLE KFYQLPSSRY RSARKNSTSM
Cebus_imitator                MFCLKTLPFL LLLHVQISKA FPVSS--KEK DTKIVQ---- -------DYLE KFYQLPSNQH QSIRKNSINM
Gorilla_gorilla               MFSLKTLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Lemur_catta                   MFYLKTLPFL LLLHMELSKA FPVPS--EEK NAKIVQ---- -------DYLE KFYRLPSNQY RTARKNSPST
Macaca_mulatta                MFSLKMLLFL LLLHVQISKA FPVSS--KEE NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTSM
Macaca_nemestrina             ---------- -------MQQ IP-------- QEKSIN---- -------DYLE KFYQLPSNQY QSTRKNGTSM
Microcebus_murinus            MFCLKTLPLL LLLHMELSKA FPVPS--EGR NAKIVQ---- -------DYLE KFYRLPSNQY RTARKNSASM
Nomascus_leucogenys           MFALKTLPFL LLLHVHISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Nycticebus_coucang            MFCLKTLLFL LLLHVQLSKT FPVVS--AEK NTKLIQ---- -------DYLE KFYQLPSNRY RTSRKNSTTM
Otolemur_garnettii            MFRLKTLVFL LLLHVPLSKT FPVVS--AEK NTKLIQ---- -------DYLE KFYQLPSNRY RTSRKNSTTM
Pan_paniscus                  MFSLKTLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Pan_troglodytes               MFSLKMLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Papio_anubis                  MFSLKMLPFL LLLHVQISKA FPVSS--KEE NTKIVQ---- -------DYLE KFYQLPSNQY QSMRKNGTSM
Piliocolobus_tephrosceles     MFSLKTLPFL FLLHVQISKA FPVSS--KEE NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTSM
Pongo_abelii                  MFSLKTLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Pongo_pygmaeus                -MCRFPRPFL YLLKRKIQKL FSTRP--SQK PTRCSHLILD FPASKIDYLE KFYQLPSNQY QSTRKNGTNV
Saimiri_boliviensis           MFCLKRLPFL LLLHVQISKA FPVSF--KEK DTKIVQ---- -------DYLE KFYQLPSNQY QSIRKNSINM
Sapajus_apella                MFCLKTLPFL LLLHVQISKA FPVSS--KEK DTKIVQ---- -------DYLE KFYQLPSNQY QSIRKNSINM
Symphalangus_syndactylus      MFALKTLPFL LLLHVHISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Theropithecus_gelada          MFSLKMLPFL LLLHVQISKA FPVSS--KEE NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTSM
Trachypithecus_francoisi      MFSLKTLPFL LLLHVQISKA FPLSS--KEE NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTSM
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                              71
Homo_sapiens                  IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGG FMLTPGNPKW ERTNLTYRIR NYTPQLSEAE
Mus_musculus                  VAEKLKEMQR FFSLAETGKL DAATMGIMEM PRCGVPDSGD FLLTPGSPKW THTNLTYRII NHTPQLSRAE
Aotus_nancymaae               IVEKLKEMQR FFGLNVTGKP NAETLEMMKQ PRCGVPDSGD FMITPGNPKW EQTNLTYRII NYTPQLSETE
Carlito_syrichta              IVEKLKEMQR FFGLNVTGKP DAETLETMEK PRCGVPDRGD FMLTPGNPKW KHTNLTYRII NYTPQLSEAD
Cebus_imitator                IVEKLKEMQQ FFGLNVTGKP NAETLEMMKQ PRCGVPDSGD FMITPGNPKW EQTNLTYRII NYTPQLSETE
Gorilla_gorilla               IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGG FMLTPGNPKW EHTNLTYRIR NYTPQLSVAE
Lemur_catta                   IVEKLKEMQR FFRLNVTGKP DAETLEVMEK PRCGVPDSGD FAITPGNPKW EHTNLTYRII SYTQQLSEAD
Macaca_mulatta                IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMLTPGNPKW ERTNLTYSIL NYTPQLSETD
Macaca_nemestrina             IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMLTPGNPKW ERTNLTYSIL NYTPQLSETD
Microcebus_murinus            VVEKLKEMQR FFGLNVTGKP DAETLEVMEK PRCGVPDSSS FMITPGSPKW EHTNVTYRII SHTQQLSVAE
Nomascus_leucogenys           IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMITPGNPKW ERTNLTYRIR NYTPQLSKAD
Nycticebus_coucang            IVEKLKEMQR FFGLNVTGKP NAETLEMMEK PRCGVPDTAG FVLTPGNPKW EHINLTYRFI NYTPQLSKTD
Otolemur_garnettii            IVEKLKEMQR FFGLNVTGKP NAETLEMMEK PRCGVPDTAG FMLTPGSPKW EHTNLTYRFI NYTPQLSKTD
Pan_paniscus                  IIEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGG FMLTPGNPKW ERTNLTYRIR NYTPQLSEAE
Pan_troglodytes               IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGG FMLTPGNPKW EHTNLTYRIR NYTPQLSEAE
Papio_anubis                  IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMLTPGNPKW EHTNLTYRIL NYTPQLSETD
Piliocolobus_tephrosceles     IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDTGD FMLTPGNPKW KHTNLTYSIL NYTPQLSQTD
Pongo_abelii                  IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGE FMLTPGNPKW ERTNLTYRIR NYTPQLSEDD
Pongo_pygmaeus                IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGE FMLTPGNPKW ERTNLTYRIR NYTPQLSEDD
Saimiri_boliviensis           IVEKLKEMQR FFGLNVTGKP DAETLEMMKQ PRCGVPDSGD FMITPGNPKW EQTNLTYRFI NYTPQLSVTE
Sapajus_apella                IVEKLKEMQQ FFGLNVTGKP NAETLEMMKQ PRCGVPDSGD FMITPGNPKW EQTNLTYRII NYTPQLSETE
Symphalangus_syndactylus      IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMITPGNPKW ERTNLTYRIR NYTPQLSKTD
Theropithecus_gelada          IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMLTPGNPKW ERTNLTYRIL NYTPQLSETD
Trachypithecus_francoisi      IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDTGD FMLTPGNPKW KHTNLTYSIL NYTPQLSKTD
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                              141
Homo_sapiens                  VERAIKDAFE LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Mus_musculus                  VKTAIEKAFH VWSVASPLTF TEILQGEADI NIAFVSRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDS
Aotus_nancymaae               VETAIGNAFK VWSNASSLTF TRISQGEANI SIAFFHRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDA
Carlito_syrichta              VDSAIERAFE LWSHASPLRF TRISQGEPDI KIAFVQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Cebus_imitator                VERAIGDAFK VWSDVSPLTF TRISQGEADI NIAFYQKDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Gorilla_gorilla               VERAIKDAFE LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Lemur_catta                   VETAIEKAFK VWSDVSPLTF TRISRGEADI KIAFYLRDHG DNSPFDGPNG ILAHAFQPGR GIGGDVHFDA
Macaca_mulatta                VEGAIKKAFE VWSKASPLTF TRISQGQADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Macaca_nemestrina             VEGAIKKAFE VWSKASPLTF TRISQGQADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Microcebus_murinus            VGAAFEKAFK LWSGASPLTF TRISQGEADI KIAFVQRDHG DNSPFDGPNG ILAHAFQPGP GIGGDVHFDA
Nomascus_leucogenys           VERAIEKAFK VWSDASPLTF TRISQGEADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Nycticebus_coucang            VETVIEKAFE VWSKASPLTF TKISQGEADI KIAFVRREHG DNSPFDGPNG ILAHAFQPGR GIGGDVHFDE
Otolemur_garnettii            VETVIEKAFE VWSKASPLTF TKTAQGEADI KIAFVQKDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDE
Pan_paniscus                  VERAIKDAFK LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Pan_troglodytes               VERAIKDAFE LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Papio_anubis                  VEGAIKKAFE VWSKASPLTF TRISQGQADI NIGFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Piliocolobus_tephrosceles     VEGTIKKAFE VWSKVSPLTF TRISQGDADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Pongo_abelii                  VKTAIEKAFE VWSKASPLTF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDA
Pongo_pygmaeus                VKTAIEKAFE VWSKASPLTF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDA
Saimiri_boliviensis           VETAIGNAFK IWSDPSPLTF TRISQGEADI NIAFFPRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Sapajus_apella                VETAIGDAFK VWSDVSPLTF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Symphalangus_syndactylus      VERAIEKAFK VWSDASPLTF TRISQGEADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Theropithecus_gelada          VEGAIKKAFE VWSKASPLTF TRISQGQADI NIGFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Trachypithecus_francoisi      IEGAIKKAFE VWSKVSPLTF TRISQGEADI NIGFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
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                             211
Homo_sapiens                 EETWTNTSAN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDIDGIQ AIYGLSSNPI
Mus_musculus                 EETWTQDSKN YNLFLVAAHE FGHSLGLSHS TDPGALMYPN YAYREPSTYS LPQDDINGIQ TIYGPSDNPI
Aotus_nancymaae              EETWTSTSKN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYS LPQDDINGIQ AIYGPSSNPI
Carlito_syrichta             EETWTKTSAN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYL LPQDDINGIQ AIYGPSDNPI
Cebus_imitator               EETWTNTSEN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYS LPQDDINGIQ AIYGPSSNPI
Gorilla_gorilla              EETWTNTSAS YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDIDGIQ AIYGLSSNPI
Lemur_catta                  EETWTTNANN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFREPSTYT LPQDDINGIQ AIYGPSSNPV
Macaca_mulatta               EETWTKTSTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Macaca_nemestrina            EETWTKNSTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Microcebus_murinus           EETWTTNFNN YNLFLVAAHE FGHSLGLAHS SDAGALMYPN YAFSEPSTYT LPQDDINGIQ AIYGPSNNPI
Nomascus_leucogenys          EETWTKTSTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSTYS LPQDDIDGIQ AIYGPSSNPI
Nycticebus_coucang           EETWTTTAVN YNLFLVAAHE FGHSLGLSHS TDPGALMYPN YAFNDPSTYS LPQDDINGIQ AIYGPSSSPV
Otolemur_garnettii           EETWTTTSIN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFNEPSTYS LPQDDINGIQ AIYGPSNSPV
Pan_paniscus                 EETWTDTSAN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDIDGIQ AIYGLSSNPI
Pan_troglodytes              EETWTDTSAN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDIDGIQ AIYGLSSNPI
Papio_anubis                 EETWTKDFTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Piliocolobus_tephrosceles    EETWTTNSTN YNLFLVAAHE FGHSLGLAHS FDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Pongo_abelii                 EETWTKTSAN YNLFIVAAHE FGHSLGLAHS SDPGALMYPN YAFTETSNYS LPQDDIDGIQ AIYGPSSNPV
Pongo_pygmaeus               EETWTKTSAN YNLFIVAAHE FGHSLGLAHS SDPGALMYPN YAFTETSNYS LPQDDIDGIQ AIYGPSSNPV
Saimiri_boliviensis          EETWTSTSEN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYS LPQDDINGIQ AIYGPSSNPI
Sapajus_apella               EETWTNTPEN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYS LPQDDINGIQ AIYGPSSNPI
Symphalangus_syndactylus     EETWTKTSAN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSTYS LPQDDIDGIQ AIYGPSSNPI
Theropithecus_gelada         EETWTKDFTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Trachypithecus_francoisi     EETWTTNSTN YNLFLVAAHE FGHSLGLAHS FDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
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                          281
Homo_sapiens              QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Mus_musculus              QPTGPSTPKA CDPHLRFDAT TTLRGEIYFF KDKYFWRRHP QLRTVDLNFI SLFWPFLPNG LQAAYEDFDR
Aotus_nancymaae           QPTGPSTPRP CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Carlito_syrichta          QPTGPSTPRT CDPRLTFDAI TTLRGEIFFF RDKYFWRRHP QLRSIEFNFI SLFWPALPDS IQAAYEDLDR
Cebus_imitator            QPTGPSTPRP CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Gorilla_gorilla           QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Lemur_catta               QPTGPSTPRS CDPRLTFDAI TTLRGEILFF KDKYFWRRHP QLRSVELNFI SLFWPNLPNG IQAAYEDFDR
Macaca_mulatta            QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Macaca_nemestrina         QPTGPTTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Microcebus_murinus        QPTGPSTPMA CDPRLTFDAI TTLRGEIFFF KDKYFWRRHP QLRSVELNFI SLFWPSLPNG IQAAYEDFDK
Nomascus_leucogenys       QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDSDR
Nycticebus_coucang        QPTGPSTPRT CDPRLTFDAI TTLRGEILFF KDKYFWRKHP QLPTVELNFI SLFWPSLPNG IQAAYEDFDR
Otolemur_garnettii        QPTGPSTPRT CDPRLTFDAI TTLRGEILFF KDKYFWRKHP QLPTAELNFI SLFWPSLPNG IQAAYEDFER
Pan_paniscus              QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Pan_troglodytes           QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Papio_anubis              QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Piliocolobus_tephrosceles QPTGPSTPES CDPRLTFDAI TTLRGEILFF KDEYFWRRHP WLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Pongo_abelii              QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRIEMNFI SLFWPSLPTG MQAAYEDFDR
Pongo_pygmaeus            QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRIEMNFI SLFWPSLPTG MQAAYEDFDR
Saimiri_boliviensis       QPTGPSTPRS CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLRRVEMNFI SLFWPSLPTG IQAAYEDFDR
Sapajus_apella            QPTGPSTPRP CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Symphalangus_syndactylus  QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Theropithecus_gelada      QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Trachypithecus_francoisi  QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
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| | 351 | | | | | | |
|---|---|---|---|---|---|---|---|
| Homo_sapiens | DLIFLFKGNQ | YWALSGYDIL | QGYPKDISNY | GFPSSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQFMEPG |
| Mus_musculus | DLVFLFKGRQ | YWALSGYDLQ | QGYPRDISNY | GFPRSVQAID | AAVSYNGKTY | FFINNQCWRY | DNQRRSMDPG |
| Aotus_nancymaae | DLVFLFKGNQ | YWALSGYDIQ | QGYPRDISNY | GFPSSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQFMEPG |
| Carlito_syrichta | DLVFLFKGNQ | YWAMNGYDLQ | PGYPRDISNY | GFPSNVQAID | AAVYFRSKTY | FFVNDQFWRY | DNERQTMEPG |
| Cebus_imitator | DLVFLFKGNQ | YWALSGYDIQ | QGYPRDISNY | GFPSSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQLMEPG |
| Gorilla_gorilla | DLIFLFKGNQ | YWALSGYDIL | QGYPKDISNY | GFPSSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQFMEPG |
| Lemur_catta | DLVFLFKGNQ | YWALSGYDIQ | QGYPRYISNY | GFPSTVQAID | AAVSYGSETY | FFVNDQFWRY | DNQRQAMDPG |
| Macaca_mulatta | DLIFLFKGNQ | YWAVSGYDIQ | QGYPRDISNY | GFPSSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQFMEPG |
| Macaca_nemestrina | DLIFLFKGNQ | YWAVSGYDIQ | QGYPRDISNY | GFPSSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQFMEPG |
| Microcebus_murinus | DLVFLFKGNQ | YWAMSGYDIQ | QGYPRHISNY | GFPSNVQAID | AAVSYGRKTY | FFVNDQLWRY | DNQRQAMDPG |
| Nomascus_leucogenys | DLIFLFKGNQ | YWALSGYDIQ | QGYPKSISNY | GFPCSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQFMEPG |
| Nycticebus_coucang | DLVFLFKGNQ | YWALNGYDIQ | EGYPRDISNY | GFPSTVQAID | AAVSYRRKTY | FFVNDQFWRY | DNQRQLMEPG |
| Otolemur_garnettii | DLVFLFKGNQ | YWALNGYEIQ | QGYPRDISNY | GFPSTVQAVD | AAVFYRRKTY | FFVNDQFWRY | DNQRQFMEPG |
| Pan_paniscus | DLIFLFKGNQ | YWALSGYDIL | QGYPKDIANY | GFPSSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQFMEPG |
| Pan_troglodytes | DLIFLFKGNQ | YWALSGYDIL | QGYPKDIANY | GFPSSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQFMEPG |
| Papio_anubis | DLIFLFKGNQ | YWAVSGYDIQ | QGYPRDISNY | GFPSSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQFMEPG |
| Piliocolobus_tephrosceles | DLIFLFKGNQ | YWAVSGYDIQ | QGYPRDISNY | GFPSSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQFMEPG |
| Pongo_abelii | DLIFLFKGNQ | YWALSGYDIL | QGYPKNISNY | GFPSSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQFMEPG |
| Pongo_pygmaeus | DLIFLFKGNQ | YWALSGYDIL | QGYPKNISNY | GFPSSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQFMEPG |
| Saimiri_boliviensis | DLVFLFKGNQ | YWALSGYDIQ | QGYPRDISNY | GFPSSVQAID | AAVFYKSKTY | FFVNDQFWRY | DNQRQFMEPG |
| Sapajus_apella | DLVFLFKGNQ | YWALSGYDIQ | QGYPRDISNY | GFPSSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQLMEPG |
| Symphalangus_syndactylus | DLIFLFKGNQ | YWALSGYDIQ | QGYPKSISNY | GFPCSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQFMEPG |
| Theropithecus_gelada | DLIFLFKGNQ | YWAVSGYDIQ | QGYPRDISNY | GFPSSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQFMEPG |
| Trachypithecus_francoisi | DLIFLFKGNQ | YWAVSGYDIQ | QGYPRDISNY | GFPSSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQFMEPG |

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                              421
Homo_sapiens                  YPKSISGAFP GIESKVDAVF QQEHFFHVFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Mus_musculus                  YPKSIPSMFP GVNCRVDAVF LQDSFFLFFS GPQYFAFNFV SHRVTRVARS NLWLNCS--
Aotus_nancymaae               YPQSISYIFP GIESKVDAVF QQEHFFLFFS GPLYYAFDLS AQRVTRVARG NKWLNCR--
Carlito_syrichta              YPKSTLSIFP GIESKVDAVF QQNYFFFFFS GPRFYAFDLQ AHRVTRVDRS NRWLNCR--
Cebus_imitator                YPQRISDIFP GIERKVDAVF QQEHFFLFFS GPIYYAFDLS AQRVTRVARG NKWLNCR--
Gorilla_gorilla               YPKSISGAFP GIESKVDAVF QQQHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Lemur_catta                   YPQSILRTFP GIQSKVDAVF QKDDFFLFFS GPLYYAFNLS TRRVTRIDRS NKWLNCR--
Macaca_mulatta                YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Macaca_nemestrina             YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Microcebus_murinus            YPQSISSTFP GIQSRVDAVF QQDDFFLFFS GPRYYAFNLS TNRVTRLDKS NKWLNCR--
Nomascus_leucogenys           YPKSISGTFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVERG NKWLNCRYG
Nycticebus_coucang            YPKSLSTAFP GIESRVDAVF QRDYVFLFFS GPRYYAFDLN TRRVIRIDRS NIWLNCR--
Otolemur_garnettii            YPKSISTAFP GIESRVDAVF HRDYVFVFFS GPRYYAFDLN TRRVIRIDRS NKWLNCR--
Pan_paniscus                  YPKSISGAFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Pan_troglodytes               YPKSISGAFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Papio_anubis                  YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Piliocolobus_tephrosceles     YPKSTSGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTTVARA NEWLNCRYS
Pongo_abelii                  YPKSISDTFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Pongo_pygmaeus                YPKSISDTFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCR--
Saimiri_boliviensis           YPQSISGIFP GIESKVDAVF QQEHFFLFFS GPIYYAFDLS AQRVTKIARG NKWLNCR--
Sapajus_apella                YPQRISDIFP GIERKVDAVF QQEHFFLFFS GPIYYAFDLS AQRVTRVARG NKWLNCR--
Symphalangus_syndactylus      YPKSISDTFP GIESKVDAVF QQERFFLFFS GPRYYAFDLI AQRVTRVERG NKWLNCRYG
Theropithecus_gelada          YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Trachypithecus_francoisi      YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
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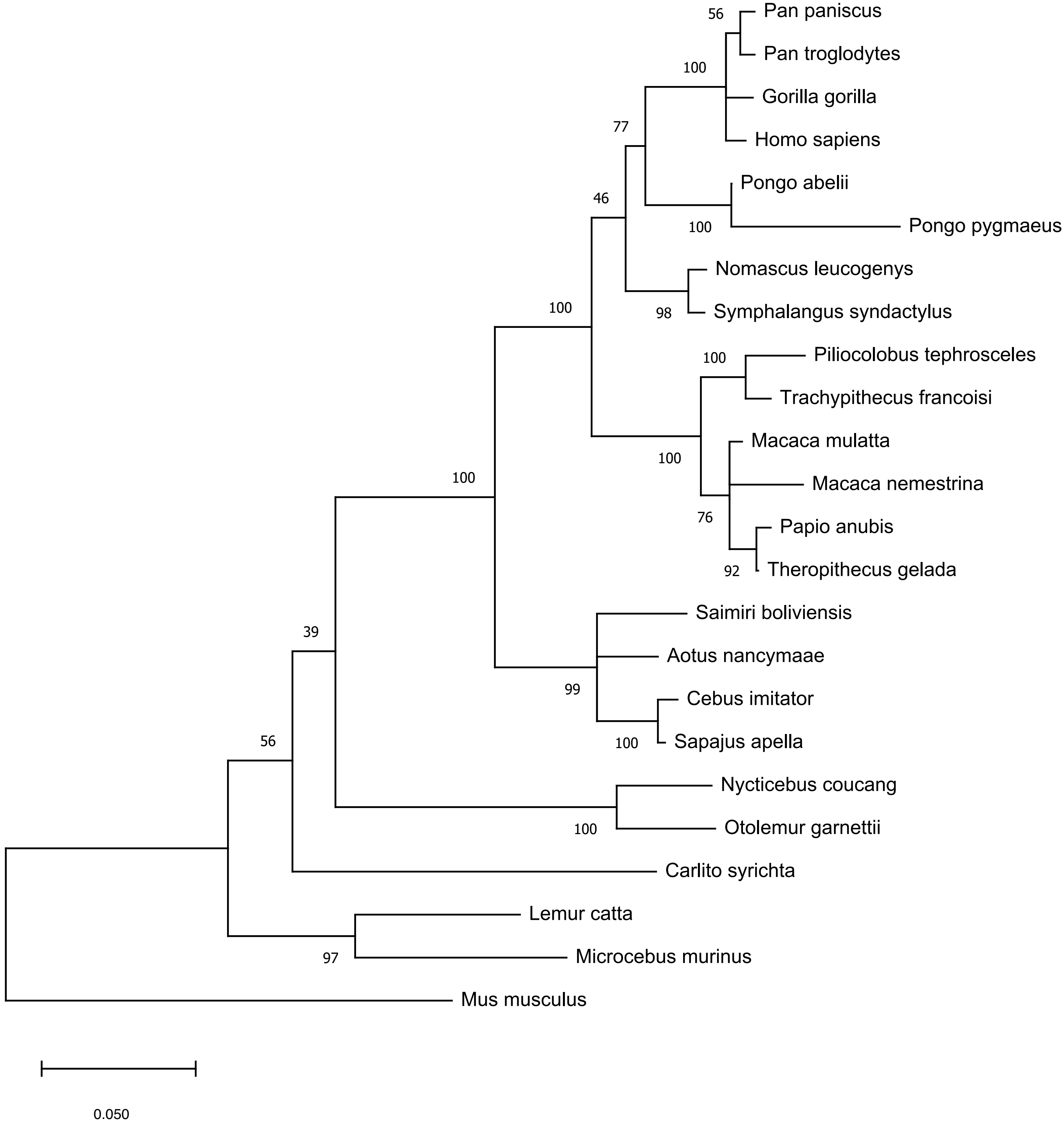

Pan paniscus
Pan troglodytes
Gorilla gorilla
Homo sapiens
Pongo abelii
Pongo pygmaeus
Nomascus leucogenys
Symphalangus syndactylus
Piliocolobus tephrosceles
Trachypithecus francoisi
Macaca mulatta
Macaca nemestrina
Papio anubis
Theropithecus gelada
Saimiri boliviensis
Aotus nancymaae
Cebus imitator
Sapajus apella
Nycticebus coucang
Otolemur garnettii
Carlito syrichta
Lemur catta
Microcebus murinus
Mus musculus
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Mus_musculus                   MHSAILATFF LLSWTPCWSL PLPYGDDDDD DLSEEDLVFA EHYLKSYYHP ATLAGILKKS TVTSTVDRLR
Aotus_nancymaae                MHLGVLAAFL FLNWTHCRAL PLPNG-DDED DLSEEDLQFA ERYLKLYYHP TNLAGILKKN SANSMADRLR
Carlito_syrichta               MHPGVLTAFL LLCWTQCQSL PLPNG-EDED DTSEEDLQFA ERYLRSFYHP VNLAGILKKN AASSMVDRLR
Cebus_imitator                 MHPGVLAAFL FLSWTHCWAL PLPNG-DDED DLSEEDLQFA ERYLKLYYHP TNLAGILKKN SASSMTDRLR
Gorilla_gorilla                MHPGVLAAFL FLSWTHSRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Lemur_catta                    MHPGILVAFL FLSWTHCRSL PLPNG--DDD DLSEEDLQFA ERYLKSYYHP PNLAGILKET SASSMVDRLR
Macaca_mulatta                 MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Macaca_nemestrina              MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Microcebus_murinus             -MQGVLVAFL FLSWTHCRSL PLPDG--DDD DLSEEDLQFA ERYLKSYYHP PILAGILKKT SASSMVDRLR
Nomascus_leucogenys            MHPGILAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Nycticebus_coucang             MLPGVLLAFL FLSWTHCRAL PLPND-DDDD DLSEEDLQFA ERYLKSYYYP PNLAGILKKT SASSMIDRLR
Otolemur_garnettii             MLPRVLLAFL FLSWTPCRAL PLPNG--DDD DLSEEDLQFA EHYLKSYYHP LNLAGILKKT SASSMIDRLR
Pan_paniscus                   MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTERLR
Pan_troglodytes                MHPGVLAAFL FLSWAHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTERLR
Papio_anubis                   MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Piliocolobus_tephrosceles      MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Pongo_abelii                   MHPGVLAAFL FLSWTHCRAL PLPSD-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Pongo_pygmaeus                 MHPGVLAAFL FLSWTHCRAL PLPSD-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Saimiri_boliviensis            MHPGVLAAFL FLSWTHCRAL PLPNG-DDED DLSEEDLQFA ERYLKLYYHP TNLAGILKKN SASSMTDRLR
Sapajus_apella                 MHPGVLAAFL FLSWTHCWAL PLPNG-DDED DLSEEDLQFA EHYLKLYYHP TNLAGILKKN SASSMTDRLR
Symphalangus_syndactylus       MHPGILAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Theropithecus_gelada           MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Trachypithecus_francoisi       MHPVVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
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Homo_sapiens                  EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Mus_musculus                  EMQSFFGLEV TGKLDDPTLD IMRKPRCGVP DVGEYNVFPR TLKWSQTNLT YRIVNYTPDM SHSEVEKAFR
Aotus_nancymaae               EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Carlito_syrichta              EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIENYTPDM PHSEVEKAFK
Cebus_imitator                EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWPKMNLT YRIVNYTPDM THSEVEKAFK
Gorilla_gorilla               EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Lemur_catta                   EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWTQTNLT YRIVNYTPDM PHSEVEKAFK
Macaca_mulatta                EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Macaca_nemestrina             EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Microcebus_murinus            EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWTQTNLT YRIVNYTPDM THSEVEKAFK
Nomascus_leucogenys           EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Nycticebus_coucang            EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWTKTNLT YRIVNYTPDM THSEVEKAFK
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Pan_paniscus                  EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Pan_troglodytes               EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Papio_anubis                  EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Piliocolobus_tephrosceles     EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Pongo_abelii                  EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Pongo_pygmaeus                EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Saimiri_boliviensis           EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWSRMNLT YRIVNYTPDM THSEVEKAFK
Sapajus_apella                EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWPKMNLT YRIVNYTPDM THSEVEKAFK
Symphalangus_syndactylus      EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Theropithecus_gelada          EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Trachypithecus_francoisi      EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWSKVNLT YRIVNYTPDM THSEVEKAFK
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Mus_musculus                  KAFKVWSDVT PLNFTRIYDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Aotus_nancymaae               KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Carlito_syrichta              KAFKVWSDVT PLNFTRMHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Cebus_imitator                KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Gorilla_gorilla               KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Lemur_catta                   KAFKVWSDVT PLNFTRLHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Macaca_mulatta                KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Macaca_nemestrina             KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Microcebus_murinus            KAFKVWSDVT PLNFTRLHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNLGGDA HFDDDETWTS
Nomascus_leucogenys           KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Nycticebus_coucang            KAFKVWSDVT PLNFTRLHDG TADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Otolemur_garnettii            KAFKVWADVT PLNFTRLHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pan_paniscus                  KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pan_troglodytes               KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Papio_anubis                  KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Piliocolobus_tephrosceles     KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pongo_abelii                  KAFKVWSDVT PLNFTRLHNG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pongo_pygmaeus                KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Saimiri_boliviensis           KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Sapajus_apella                KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Symphalangus_syndactylus      KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Theropithecus_gelada          KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Trachypithecus_francoisi      KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
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211

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| Homo_sapiens | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Mus_musculus | SSKGYNLFIV | AAHELGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQFLYGPG | DEDPNPKHPK |
| Aotus_nancymaae | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQFLYGPG | DEDPNPKHPK |
| Carlito_syrichta | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | NHFVLPDDDV | QGIQTLYGPG | DEDPNPKHPK |
| Cebus_imitator | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTSK | SHFMLPDDDV | QGIQFLYGPG | DEDPNPKHPK |
| Gorilla_gorilla | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Lemur_catta | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFVLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Macaca_mulatta | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Macaca_nemestrina | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Microcebus_murinus | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFVLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Nomascus_leucogenys | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Nycticebus_coucang | SSKGYNLFLV | AAHELGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPEDDV | QGIQFLYGPG | DEDPNPKHPK |
| Otolemur_garnettii | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFVLPEDDV | QGIQSLYGPG | DEDPNPKHPK |
| Pan_paniscus | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Pan_troglodytes | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Papio_anubis | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFVLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Piliocolobus_tephrosceles | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Pongo_abelii | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Pongo_pygmaeus | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Saimiri_boliviensis | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTSK | NHFMLPDDDV | QGIQFLYGPG | DEDPNPKHPK |
| Sapajus_apella | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTSK | SHFMLPDDDV | QGIQFLYGPG | DEDPNPKHPK |
| Symphalangus_syndactylus | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Theropithecus_gelada | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFVLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Trachypithecus_francoisi | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |

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Aotus_nancymaae               TPDKCDPSLS LDAITSLRGE TMVFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSRDLIFIF
Carlito_syrichta              TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSRDLIFIF
Cebus_imitator                TPDKCDPSLS LDAITSLRGE TMVFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Gorilla_gorilla               TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSYDLIFVF
Lemur_catta                   TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPAHDLVFVF
Macaca_mulatta                TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Macaca_nemestrina             TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Microcebus_murinus            TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLVFFF
Nomascus_leucogenys           TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Nycticebus_coucang            TPDKCDPSLS LDAITSLRGE TIIFKDRFFW RLHPQQVDAE LFLTKSFWME LPNRIDAAYE HPSHDLVFIF
Otolemur_garnettii            TPDKCDPSLS LDAITNLRGE TIIFKDRFFW RLHPQQVDAE LFLTKSFWLE LPNRIDAAYE HPSHDLVFIF
Pan_paniscus                  TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Pan_troglodytes               TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Papio_anubis                  TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Piliocolobus_tephrosceles     TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Pongo_abelii                  TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Pongo_pygmaeus                TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Saimiri_boliviensis           TPDKCDPSLS LDAITSLRGE TMVFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Sapajus_apella                TPDKCDPSLS LDAITSLRGE TMVFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Symphalangus_syndactylus      TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Theropithecus_gelada          TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Trachypithecus_francoisi      TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
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Aotus_nancymaae               RGRKFWALNG YDILEGYPKK ISELGFPKEI KKISAAVHFE DTGRTLFFSG NHVWRYDDTN QIMDKDYPRL
Carlito_syrichta              RGRKFWALNG YDIMEGYPQK ISELGFPKEV KKISAAVHFE DTGKTLFFSG NQVWSYDDTN HVMDKDYPRF
Cebus_imitator                RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGRTLFFSG NQVWRYDDTN QIMDKDYPRL
Gorilla_gorilla               RGRKFWALNG YDILEGYPKK ISELGLPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Lemur_catta                   RGRKFWALNG YDIMEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLFFSG NQVWRYDDTN HIMDTDYPRL
Macaca_mulatta                RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Macaca_nemestrina             RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Microcebus_murinus            RGRKFWALNG YDIMEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLFFSG NQVWRYDDTN QIMDKDYPRL
Nomascus_leucogenys           RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Nycticebus_coucang            RGRKFWALNG YDIMEGYPKK ISELGFPKEV KKISAAVHFE DRGKTLFFSG NQVWSYDDTN HIMDKDYPRL
Otolemur_garnettii            RGRKFWALNG YDIMEGYPKK ISELGFPKEV KKISAAVHFE DRGKTLFFSG NQVWSYDDTN HIMDKDYPRL
Pan_paniscus                  RGRKFWALNG YDILEGYPKK ISELGLPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Pan_troglodytes               RGRKFWALNG YDILEGYPKK ISELGLPKEV KKISATVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Papio_anubis                  RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Piliocolobus_tephrosceles     RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Pongo_abelii                  RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Pongo_pygmaeus                RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Saimiri_boliviensis           RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLFFSG NQVWRYDDTN QIMDKDYPRL
Sapajus_apella                RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGRTLFFSG NQVWRYDDTN QIMDKDYPRL
Symphalangus_syndactylus      RGRKFWALNG YDILEGYPQK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Theropithecus_gelada          RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Trachypithecus_francoisi      RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
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Cebus_imitator                IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSKRI VRVMPANSIL
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Nycticebus_coucang            IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSDRI VRVMPTNALL
Otolemur_garnettii            IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPTNALL
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Pongo_pygmaeus                IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Saimiri_boliviensis           IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSKRI VRVMPANSIL
Sapajus_apella                IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSKRI VRVMPANSIL
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Theropithecus_gelada          IEEDFPGIGD KVDAVYEKNE SHFVVQAGVQ WHNLSSLQPP PPGFKRFSCL SLRSSWNYRL YLFFQRAHTV
Trachypithecus_francoisi      IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
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                              491
Homo_sapiens                    WC
Mus_musculus                    WC
Aotus_nancymaae                 WC
Carlito_syrichta                WC
Cebus_imitator                  WC
Gorilla_gorilla                 WC
Lemur_catta                     WC
Macaca_mulatta                  WC
Macaca_nemestrina               LC
Microcebus_murinus              WC
Nomascus_leucogenys             WC
Nycticebus_coucang              WC
Otolemur_garnettii              WC
Pan_paniscus                    WC
Pan_troglodytes                 WC
Papio_anubis                    WC
Piliocolobus_tephrosceles       WC
Pongo_abelii                    WC
Pongo_pygmaeus                  WC
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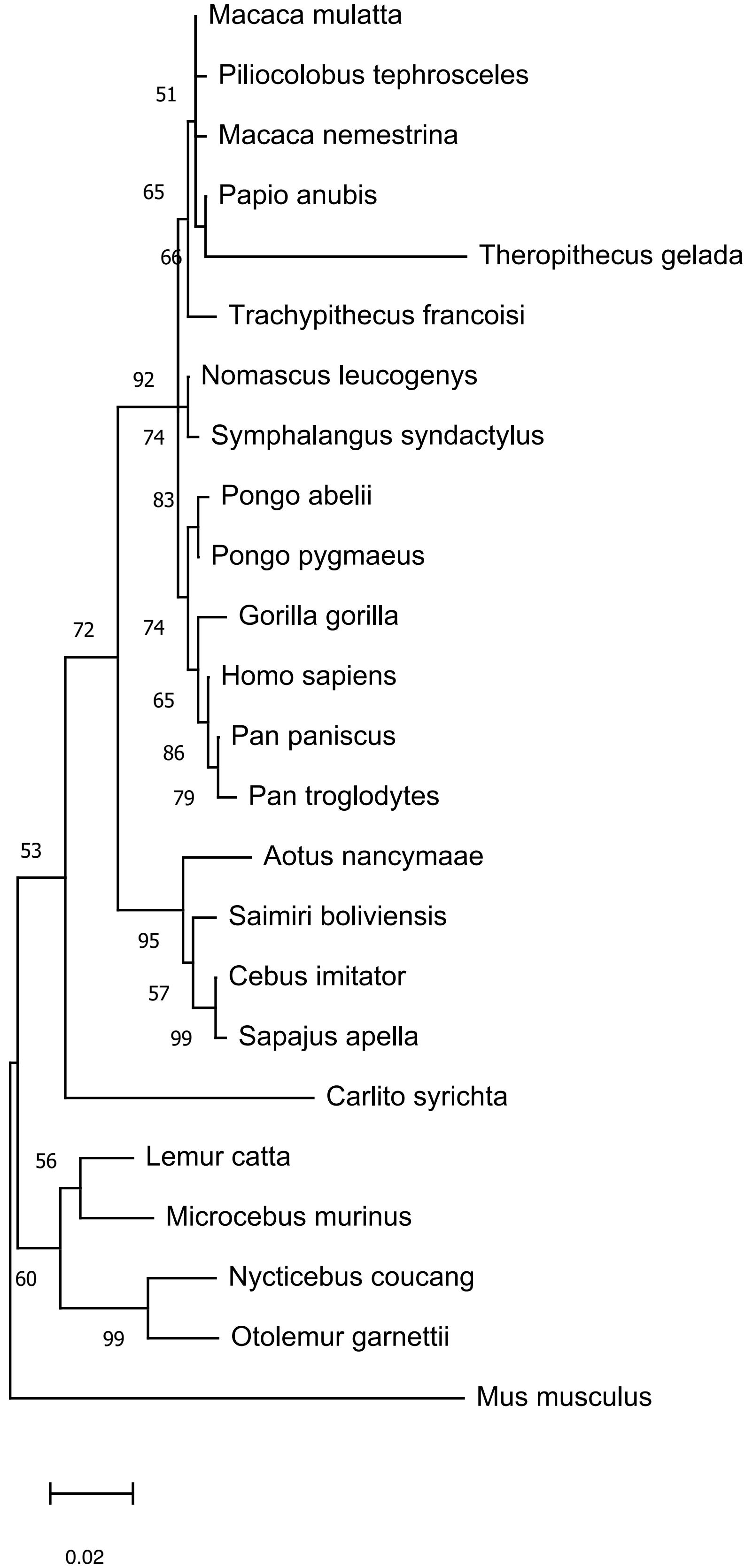
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Macaca nemestrina
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Pongo abelii
Pongo pygmaeus
Gorilla gorilla
Homo sapiens
Pan paniscus
Pan troglodytes
Aotus nancymaae
Saimiri boliviensis
Cebus imitator
Sapajus apella
Carlito syrichta
Lemur catta
Microcebus murinus
Nycticebus coucang
Otolemur garnettii
Mus musculus
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A glimpse on the discussions…



# A STUDY ON GRASSHOPPER DIVERSITY IN CHRIST COLLEGE (AUTONOUMOUS), IRINJALAKUDA

DEPARTMENT OF ZOOLOGY,
CHRIST COLLEGE (AUTONOMOUS),
IRINJALAKUDA
THRISSUR, KERALA-680 125

MARCH 2024

# A STUDY ON GRASSHOPPER DIVERSITY IN CHRIST COLLEGE IRINJALAKUDA

***Project report submitted to the University of Calicut in partial fulfillment of the requirement for the award of the Degree***

## BACHELOR OF SCIENCE IN ZOOLOGY



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**Examiners:**

**1.** **2.**

# DECLARATION

We, Akshay K A, Aleena Mariya, Anagha Arun M A, Anagha Saibu, Anjima Jose, Mariya T J, Neethu N M, Rahma and Sandra K Shaju, do hear by declare that this project entitled "**Study on grasshopper diversity in Christ College (Autonomous), Irinjalakuda**" is a genuine record of project work done by us under the guidance of Dr. Bijoy C., Assistant Professor, Department of Zoology, Christ College (Autonomous), Irinjalakuda, and has not been submitted to any university or Institution for the Award of any Degree or Diploma.

We further declare that results presented in this work and considerations made therein, contribute in general to the advancement of knowledge in science.

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# CERTIFICATE

This is to certify that the content of this project work entitled "**STUDY ON GRASSHOPPER DIVERSITY IN CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA**" is an original work done by the following students under my supervision and guidance at the Department of Zoology, Christ College (Autonomous), Irinjalakuda. I further certify that no part of the work has been presented for the award of any other Degree or Diploma.

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**Date:**

**Dr. Bijoy C.**

Project Supervisor

## CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA

## DEPARTMENT OF ZOOLOGY

## CERTIFICATE

This is to certify that the project work entitled **‘A study on grasshopper diversity in Christ College (Autonomous) Irinjalakuda'** is an authentic record of research work carried out by **Akshay K A, Aleena Mariya, Anagha Arun M A, Anagha Saibu, Anjima Jose, Mariya T J, Neethu N M, Rahma** and **Sandra K Shaju** as a part of B.Sc. practical during the year 2022- 2023 and the results of this work has not been presented for the award of any other degree/diploma in any university.

Place: Irinjalakuda

Date:

**Dr. Sudhikumar A. V.**

Head, Department of Zoology,

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## ACKNOWLEDGMENTS

The success and final outcome of this project required a lot of guidance and assistance from people. Whatever we have done is only due to such guidance and assistance and we would like to express our gratitude to the following individuals without whom the work would not have been completed.

Firstly, we would like to express our heartfelt gratitude to the Almighty for providing us with the strength, wisdom, and perseverance throughout the course of this project.

We would like to express our sincere gratitude to Dr Bijoy C, Assistant Professor, Department of Zoology, Christ College, Irinjalakuda, for providing necessary advice, for his patience in bearing our ideas, and for all the efforts he made to see this project through to completion. This study would not be possible without his tremendous help and guidance. His dedication to academic excellence has been truly inspiring.

We are deeply indebted to Dr A.V. Sudhikumar, Head of Department of zoology, Christ College, Irinjalakuda, as well as all other teaching and non-teaching department personnel, for the suggestions.

We are also grateful to Rev. Dr Jolly Andrews CMI, Principal of Christ College Irinjalakuda, for providing all available resources for this project and for fostering an environment of learning and excellence at college.

We are immensely grateful to Ms. Thasnim E S, Research scholar at Shadpada Entomology Research Lab (SERL), Christ College, Irinjalakuda, for the identification of specimens, providing necessary ideas from the start of this project and for her valuable insights, and contributions to this project. Her dedication and expertise have been invaluable assets throughout the process.

Lastly, we extend our heartfelt thanks to our family for their encouragement, and support during the field trips.

# CONTENTS

## ABSTRACT

The present study is an attempt to find the diversity of grasshoppers in Christ College campus, to calculate the relative abundance of collected grasshoppers and to study their variations according to seasons and habitats. The study was carried out in four sites of Christ College campus, Irinjalakuda, Thrissur district, Kerala. Collection was done on two different seasonal period from monsoon to post monsoon. Post monsoon has the maximum species richness and monsoon shows more species diversity. According to our study, we observed 19 grasshopper species, Family Acrididae is the most abundant and Family Tetrigidae has the least abundance.

# A Bioinformatic Study on the Molecular Evolution of Collagenases in Primates

*A project report submitted to the* ***University of Calicut*** *in partial fulfilment of the requirement for the award of the Degree*

## BACHELOR OF SCIENCE IN ZOOLOGY

BY


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| 4 | Salvador VS | CCAVSZO012 |
| 5 | Abhinav Krishna PV | CCAVSZO013 |
| 6 | Aysha Nedha Sakir | CCAVSZO022 |
| 7 | Mithralmajan PT | CCAVSZO029 |
| 8 | Anjima NC | CCAVSZO035 |
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MARCH 2024

# CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA
# DEPARTMENT OF ZOOLOGY

## CERTIFICATE

This is to certify that the project work entitled **'A Bioinformatic Study on the Molecular Evolution of Collagenases in Primates'** is an authentic record of research work carried out by **Chandana Janardhanan, Lakshmi AP, Niharika, Salvador VS, Abhinav Krishna PV, Aysha Nedha Sakir, Mithralmajan PT, Anjima NC** and **Grace Maria Paulson** as part of BSc syllabus during the year **2023-2024** and the results of this work has not been presented for the award of any other degree/ diploma in any university.

### Certified bona fide by

**Dr. Leyon Varghese**
Supervising Guide

**Dr Sudhikumar A. V.**
Head, Department of Zoology

Date :

Place :

### Examined by

1. ______________________________

2. ______________________________

# DECLARATION

We, the following students do hereby declare that this project report entitled **'A Bioinformatic Study on the Molecular Evolution of Collagenases in Primates'** is a genuine record of the project work done by us under the guidance of Dr. Leyon Varghese, Assistant Professor, Department of Zoology, Christ College (Autonomous), Irinjalakuda and that this report has not been submitted to any University/Institution for the award of any Degree or Diploma. We further declare that the results presented in this work and considerations made therein, contribute in general to the advancement of knowledge in science and is devoid of any plagiarism.

| Sl. No. | Name of Students | Register No. | Signature |
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Place : Irinjalakuda

Date : 28-02-2024

## CONTENTS

## INTRODUCTION

The first true primates evolved around 55 million years ago or a bit earlier, near the beginning of the Eocene Epoch. Their fossils have been found in North America, Europe, and Asia. They looked different from the present day primates. Changes in gene regulation and differences in mRNA expression levels across primates have often been documented, however, it is not yet known to what extent measurements of divergence in mRNA levels reflect divergence in protein expression levels, which are probably more important in determining phenotypic differences. Collagenases, a subgroup of Matrix matalloproteases (MMPs) are a large family of zinc-dependent endopeptidases with a great affinity for several components of the extracellular matrix. The collagenases include MMP-1 (interstitial collagenase/collagenase-1), MMP-8 (neutrophil collagenase/collagenase-2), and MMP-13 (collagenase-3). These MMPs attack triple helical regions of interstitial collagen types I, II, and III at a specific single site after the Gly residue of the partial sequences Gly-(Ile or Leu)-(Ala or Leu), located about three-fourths of the distance from the N-terminus. This cleavage generates fragments approximately three-fourths and one-fourth of the size of the collagen molecules. They are distinct from a closely related gelatinases (MMP2 and 9) that are characterized by the presence of the additional fibronectin domain located inside the catalytic domain.

A phylogenetic tree or evolutionary tree is a graphical representation which shows the evolutionary history between a set of species or taxa during a specific time. In other words, it is a branching diagram or a tree showing the evolutionary relationships among various biological species or other entities based upon similarities and differences in their physical or genetic characteristics. In evolutionary biology, all life on Earth is theoretically part of a single phylogenetic tree, indicating common ancestry. Phylogenetics is indeed the study of this phylogenetic tree. The main challenge is to find a phylogenetic tree representing optimal evolutionary ancestry between a set of species or taxa. The first step in the phylogenetic tree construction (using bioinformatics tool) with a new sequence would be to use BLAST. This nifty yet powerful resource matches your sequence to the millions of sequences stored in genomic and nucleotide databases. The tool comes up with the sequences most similar to the query submitted.

It also gives insights as to the possible identity of those sequences. The results include homologues across species and in similar tissues or organisms. A sequence alignment is a way of arranging the sequences of DNA, RNA, or protein to identify regions of similarity that may be a consequence of functional, structural, or evolutionary relationships between the sequences. If two sequences in an alignment, they share a common ancestor and mismatches can be interpreted as point mutations and gaps as indels (that is, insertion or deletion mutations) introduced in one or both lineages in the time since they diverged from one another. In sequence alignments of proteins, the degree of similarity between amino acids occupying a particular position in the sequence can be interpreted as a rough measure of how conserved a particular region or sequence motif is among lineages.

Phylogenetics and sequence alignment are closely related fields due to the shared necessity of evaluating sequence relatedness. The field of phylogenetics makes extensive use of sequence alignments in the construction and interpretation of phylogenetic trees, which are used to classify the evolutionary relationships between homologous genes represented in the genomes of divergent species. The degree to which sequences in a query set differ is qualitatively related to the sequences evolutionary distance from one another. Roughly, high sequence identity suggests that the sequences in question have a comparatively young most recent common ancestor, while low identity suggests that the divergence is more ancient. This approximation, which reflects the “molecular clock” hypothesis that a roughly constant rate of evolutionary change can be used to extrapolate the elapsed time since two genes first diverged , assumes that the effects of mutation and selection are constant across sequence lineages.

## REVIEW OF LITERATURE

Primates are unique among placental mammals. Two extreme type of placentation are present in this single order. Strepsirrhines have non-invasive epitheliochorial placentation and Haplorhines have highly invasive haemochorial placentation. Strepsirrhines include Lemurs and Lorisiforms and Haplorhines include tarsiers and higher primates. Resemblance in placenta type provide the first evidence that tarsiers are linked to higher primates and distinct from lemurs and lorisiforms. Tree-shrews have endotheliochorial placentation and differ from both primate subgroups. Endotheliochorial placentation is primitive and epitheliochorial placentation is unlikely to be primitive.The recent availability of comprehensive molecular phylogenies for placental mammals has provided an independent framework to determine the most parsimonious interpretation of the evolution of placenta types (Robert Martin, 2008). In an earlier elaborate study, speciation between primates and rodents was estimated by looking at the protein coding genes of mitochondrial genomes from 31 mammals (A.D Yoder 2000). Based on paleontological data, three calibration points were used: one at 20–25 MYA for the hominoid/cercopithecoid divergence, one at 53–57 MYA for the cetacean/artiodactyl divergence, and the third at 110–130 MYA for the metatherian/eutherian divergence. Nulceotide and the amino acid sequence were looked at and results produced that were not mutually exclusive.

Even with decades of data and methods, we still can’t agree on the exact evolutionary tree of higher primates (apes and humans). The most likely scenario has humans closest to chimps, but other possibilities exist. Despite numerous theories, 20 key reasons cause this uncertainty. New methods using DNA offer hope for more definitive answers. (Holmquist et al 1988). Primate phylogeny forms a solid framework for a novel depiction of diverse patterns of genome evolution among primate lineages. They are essential for future comparative genomic investigation of adaptation and selection in humans and across primates. Studies on the evolution of catarrhine primates were done using molecular, fossil and bio geographical data. It was found that the common ancestor of Old World Monkeys originated in Africa and some monkeys later moved to Asia around 10 million years ago. The study further suggested that the ancestor of the

living homininds left Africa about 20 mya and the common ancestor of the living African apes returned to Africa from Eurasia around 10 mya (Caro-Beth Stewart, Todd R Disotell 1998).

In the deep study of evolutionary roots of strepsirrhine primate labyrinthine morphology, geometric morphometric analysis showed that the labyrinthine morphology of extant strepsirrhines contains a mixed locomotor, allometric and phylogenetic signal. Discriminant analysis at the family level confirmed that labyrinthine shape is a good taxonomic marker. The results support the hypothesis that evolutionary change in labyrinthine morphology is adequately described with a random walk model, i.e. random phenotypic dispersal in morphospace (Lebrun et al, 2010). An overview of the taxonomy of New World primates based on morphology to the great number of studies based on molecular data aiming for the elucidation of the phylogeny of New World monkeys. The traditional classification of the infraorder Platyrrhini divided these primates into Cebidae and the Callitrichidae, with Callimico being allocated to either the former (Simons, 1972, Simpson, 1945) or the latter family. Hill (1957) and Hershkovitz, 1972, Hershkovitz, 1977 proposed a third family – Callimiconidae – to accommodate Callimico, because it shares characteristics that define both cebids and callitrichids. According to Hershkovitz (1977), then all New World primates should be included in one of three families – the Callitrichidae which comprised the marmosets, tamarins (Saguinus) and lion tamarins (Leontopithecus), the monotypic Callimiconidae (Callimico) and the Cebidae (Schneider et al, 2015).

In a study on molecular phylogeny and evolution of primate mitochondrial DNA, researchers determined nucleotide sequences of homologous 0.9-kb fragments of mitochondrial DNAs (mtDNAs) derived from four species of old-world monkeys, one species of new-world monkeys, and two species of prosimians. With these nucleotide sequences and homologous sequences for five species of hominoids, they constructed a phylogenetic tree for the four groups of primates. The phylogeny obtained is generally consistent with evolutionary trees constructed in previous studies. The results also suggest that the rate of nucleotide substitution for mtDNAs in hominines (human, chimpanzee, and gorilla) have slowed down compared with that for old-world monkeys (Hayasaka, 1988). Mitochondrial genomes have been used to study the

phylogenetic relationship of primates in detail. Using 454 sequencing, the study adds 32 new complete mitochondrial genomes and introduces 20 previously unrepresented genera in the primate tree. The study focuses on the New world monkeys and suborder Strepsirrhini. (Knut Finstermeier, et al 2013). The evolutionary relationships of the number of species within the genus Lepilemur were analysed with the help of a comparative cytogenetic and molecular study. The study involved the complete sequencing of the mitochondrial cytochrome b gene from 68 individuals and the results were compared to those obtained from cytogenetic studies derived from 99 specimens. The results support the classification of the eight major supportive lemur taxa as independent species. (Nicole Andriaholinirina, et al. 2006)

The relationship between the prion protiens and new world primate phylogeny have been studied. The PrP C prion protein contains 250 amino acids with some variation among species and is expressed in several cell types. Variations in the prion protein gene were observed among 16 genera of New World primates (Platyrrhini), and resulted in amino acid substitutions when compared with the human sequence. Schneider et al, 2004)

Beta-globin gene cluster of primates were analyzed to understand their evolutionary history. The rate of accumulation of mutations have also been seen to vary by a factor of 7 among different primate lineages. The study groups superfamilies Lemuroidea and Lorisoidea into suborder Strepsirhini and Tarsius and Anthropoidea into suborder Haplorhini. Evolution rates have been suggested to have slowed down over the past 25 million years of hominoid descent and has found to have happened in correlation with lengthened lifespans (Koop, BF et al 1989).

Using the SINE's methods for the analysis of mobile element based of old world monkeys. It helps to known ancestral staples. Makes them to useful genetic studies for phylogenetic studies. Alu is an helping part of it, in this methods found 285 new Alu Insertions from sixteen old world monkeys. Old world monkeys are  represent on the most diverse and largest primate families. And have  respect classification. The phylogenetic researchers are classified and grouped the old world monkeys into different classes and divisions. Mainly the subfamily cerocopithecidae are the most studied group.. SINEs ( short interspersed element are

used as the genetic markers this will helps to analysis several levels of phylogenetic analysis. Using both Compcompuational and PCR methods (Xing a et al, 2005).

New world monkeys represent monophyletic group. The phylogenetic relationships among new world monkeys have been extensively investigated using nucleotide sequence from different genome.In these studies still there are some unresolved issues.There are three monophyletic new world monkey families Atelidae, Cebidae and Pitheciidae. As a result Maximum parsimony analysis support the three proposed platyrrhine families. In the maximum parsimony tree, the two most closely related families are Atelidae and Cebidae.Phylogenetic relationships were reconstructed by maximum parsimony, maximum likelihood, and Bayesian approaches (JuanC Opazo et al, 2006). Anthropoid primates from the neotropics are members of parvorder Platyrrhini. The platyrrhines are also called New World monkeys. There are more than 125 species of extant New World monkeys found in approximately 15 genera. The phylogenetic relationships of these neotropical primates have been extensively studied from a molecular perspective (Derek wildman et al, 2009).

Phylogenetic trees are certainly useful for comparative studies, providing a useful framework for comparative biologists. Species evolution is not statistically independent. The fact that close relatives inherit characteristics from their common ancestor has always complicated the analysis of cross- species data. The methods in turn developed to resolve such issues, all requires resolved phylogeny. In one of the earlier studies, primates phylogeny was estimated of all 203 species of primates. Application of parsimony algorithm and bootstrapping resulted in the composite tree with 160 nodes (Purvis, Andy 1995).

In a project conducted under the support from National Cancer Institute and National Institute of Health, researchers constructed a robust phylogenetic tree of primates. The tree was constructed from the data collected of genomic sequences from 186 primates. Also outgroup species from Dermoptera, Scandentia and Lagomorpha was included. This phylogenetic representation done carefully was a notable illumination showing the pathway of primates evolution (Perelman et.al 2011).

Studies also estimated the molecular divergence dates of major primates in the context of molecular clock studies. Such studies also aid in understanding the lineage. Utilizing the genomic data, molecular divergence dates were able to be studied since alignments can be arranged and sites can be analysed for this study. Much before the molecular clock, paleontology used to provide only a mere timeframe of species evolution (Steiper et.al. 2006).

Inferring molecular phylogeny for evolutionary studies are done in non- primates as well. The molecular phylogeny of malarial parasites was recovered from mitochondrial cytochrome b gene sequences. Parsimony as well as maximum- likelihood analysis produced similar phylogenetic trees in this case. The conclusions were supported by hypothesis testing (Perkins et.al 2002). Inferring species super matrix has helped in studying macroevolutionary dynamics and even historical biogeography. The results obtained highlighted both the power as well as limitations of inferring the molecular phylogeny data to different species concepts (Springer et.al. 2012).

Over the past 60 million years, a million copies of Alu DNA have appeared in the genomes of primates. This is still an ongoing process. DNA alu repeats in the genomes of primates such as human, chimpanzee, gorilla, orangutan, baboon, rhesus, and macaque. New Alu elements arise in unique and irreversible events and appear to prevent precise excision and loss. The same insertions cannot occur independently in two species. Once the insert is genetically fixed, the DNA elements persist in all descendant lineages. Different from point mutation, the distribution of individual alu corresponds to a phylogeny only (H. Hamdi, 1999).

To resolve the debate in strepsirrhine phylogeny, 61 loci containing interspersed elements were characterized and the absence and presence of orthologous loci in the strepsirrhine panel was determined. According to these findings, it is concluded that strepsirrhines originated in Africa, and that Madagascar and Asia were colonized by immigration events (C. Roos, 2004). To investigate the phylogenetic relationships among species of New World monkeys, 1.3 kb of DNA was collected for 2 introns of the glucose-6-phosphate dehydrogenase locus encoded on the x chromosome of 24 species of New World monkeys (M. Von. Dornum, 1999).

Two molecular based approaches are used to date the initial divergence of the platyrrhine clade, a relaxed clock model using fossil record and genome datasets, and Bayesian inferences from generation time and body size to substitution rate. Fossil constraints, topology, and substitution rate are an important part of our divergence time estimates. making an impact. Bayesian estimates using conservative and realistic fossil constraints suggest that the LCA of extant platyrrhines is 29 Ma, with a 95% confidence interval for Nodine of 27–31 Ma (SI Perez, 2013). The sequences of nuclear protein-coding gene LCAT were used to study the relationship between 19 extant rodents. The study agrees with several previous molecular and morphological studies, both concerning branching orders inside Muroidea and the bush-like radiation of rodent suprafamilial taxa. This indicates that this nuclear gene is a fitting candidate for tackling questions about rodents relationships.

The data from primates were used to reveal that the molecular clock in CpG and non-CpG sites have different nature, projecting differences in their molecular origin. Through the process, it was observed that molecular clocks are heterogeneous even within a genome. During phylogenetic analysis and while concluding divergence times using molecular data, one should be mindful that different regions of genome follow different molecular clocks. In this study, our efforts are directed towards studying the pathway of certain collagenases in the course of evolution. Even though some studies have been done using DNA sequences and that too in different context, in our study we focusses primarily on amino acid sequences. This is not a well researched area. Though this study we aim on providing a new work in the area of comparative biology. The results of the work may be useful in the future providing insights into how may be the few crucial changes in amino acids may have resulted into a complete new lineage.

## SIGNIFICANCE OF THE STUDY

The study of molecular evolution in primates through the comparison of amino acid sequences using bioinformatics tools represents a novel and underexplored area of research. To date, there has been a notable scarcity of studies employing bioinformatics techniques to investigate the evolutionary patterns of primates, particularly in relation to proteins such as MMP1, MMP8 and MMP13 collagenases. The selection of these collagenases for our study is particularly significant due to their split genes nature. By conducting a comparative analysis of the evolutionary trees derived from the collagenases with established standard trees, we aimed to shed light on the distinctive evolutionary trajectories of these proteins in primates. The insights obtained from this comparative study have the potential to deepen our understanding of the molecular evolution of primates and elucidate the factors driving the evolution of collagenases in this taxonomic group.

**OBJECTIVES**

1. Retrieval of relevant data (Gene/mRNA/protein sequence of collagenases of primates) from relevant reliable resources such as NIH or SIB.
2. Align the retrieved sequences using bioinformatics software to ensure they are in the correct reading frame and homologous positions are appropriately aligned.
3. Construction of the phylogenetic trees based on the Gene/mRNA/protein sequence of collagenases in primates.

## METHODOLOGY

The three human collagenases used in the study are MMP1, MMP8 and MMP13. The FASTA sequence and other details of collagenases are as below.

```
>NP_002412.1 interstitial collagenase isoform 1 MMP1 UniProt_P03956 [Homo sapiens]
MHSFPPLLLLLFWGVVSHSFPATLETQEQDVDLVQKYLEKYYNLKNDGRQVEKRRNSGPVVEKLKQMQEF
FGLKVTGKPDAETLKVMKQPRCGVPDVAQFVLTEGNPRWEQTHLTYRIENYTPDLPRADVDHAIEKAFQL
WSNVTPLTFTKVSEGQADIMISFVRGDHRDNSPFDGPGGNLAHAFQPGPGIGGDAHFDEDERWTNNFREY
NLHRVAAHELGHSLGLSHSTDIGALMYPSYTFSGDVQLAQDDIDGIQAIYGRSQNPVQPIGPQTPKACDS
KLTFDAITTIRGEVMFFKDRFYMRTNPFYPEVELNFISVFWPQLPNGLEAAYEFADRDEVRFFKGNKYWA
VQGQNVLHGYPKDIYSSFGFPRTVKHIDAALSEENTGKTYFFVANKYWRYDEYKRSMDPGYPKMIAHDFP
GIGHKVDAVFMKDGFFYFFHGTRQYKFDPKTKRILTLQKANSWFNCRKN

>NP_002415.1 neutrophil collagenase isoform 1 MMP8 UniProt_P22894 [Homo sapiens]
MFSLKTLPFLLLLHVQISKAFPVSSKEKNTKTVQDYLEKFYQLPSNQYQSTRKNGTNVIVEKLKEMQRFF
GLNVTGKPNEETLDMMKKPRCGVPDSGGFMLTPGNPKWERTNLTYRIRNYTPQLSEAEVERAIKDAFELW
SVASPLIFTRISQGEADINIAFYQRDHGDNSPFDGPNGILAHAFQPGQGIGGDAHFDAEETWTNTSANYN
LFLVAAHEFGHSLGLAHSSDPGALMYPNYAFRETSNYSLPQDDIDGIQAIYGLSSNPIQPTGPSTPKPCD
PSLTFDAITTLRGEILFFKDRYFWRRHPQLQRVEMNFISLFWPSLPTGIQAAYEDFDRDLIFLFKGNQYW
ALSGYDILQGYPKDISNYGFPSSVQAIDAAVFYRSKTYFFVNDQFWRYDNQRQFMEPGYPKSISGAFPGI
ESKVDAVFQQEHFFHVFSGPRYYAFDLIAQRVTRVARGNKWLNCRYG

>NP_002418.1 collagenase 3 MMP13 UniProt_P45452 [Homo sapiens]
MHPGVLAAFLFLSWTHCRALPLPSGGDEDDLSEEDLQFAERYLRSYYHPTNLAGILKENAASSMTERLRE
MQSFFGLEVTGKLDDNTLDVMKKPRCGVPDVGEYNVFPRTLKWSKMNLTYRIVNYTPDMTHSEVEKAFKK
AFKVWSDVTPLNFTRLHDGIADIMISFGIKEHGDFYPFDGPSGLLAHAFPPGPNYGGDAHFDDDETWTSS
SKGYNLFLVAAHEFGHSLGLDHSKDPGALMFPIYTYTGKSHFMLPDDDVQGIQSLYGPGDEDPNPKHPKT
PDKCDPSLSLDAITSLRGETMIFKDRFFWRLHPQQVDAELFLTKSFWPELPNRIDAAYEHPSHDLIFIFR
GRKFWALNGYDILEGYPKKISELGLPKEVKKISAAVHFEDTGKTLLFSGNQVWRYDDTNHIMDKDYPRLI
EEDFPGIGDKVDAVYEKNGYIYFFNGPIQFEYSIWSNRIVRVMPANSILWC
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The study on phylogenetic relationships in primates was conducted using this amino acid sequences to do the BLAST (Basic Local Alignment Search Tool) analysis in the NCBI Genebank database. The most suitable amino acid sequences for each primate species were then carefully selected from sequences delivered by the server. An out group was chosen which in our study was the Mus musculus of the order Rodentia.

The selected sequences were then compared with that of the out group and a phylogenetic tree was constructed based on the degree of divergence. The software used for constructing phylogenetic tree was  Molecular Evolutionary Genetics Analysis (MEGA).

## RESULTS AND DISCUSSIONS

The research article titled “A Molecular Phylogeny of Living Primates” published in 2011, established a robust and widely accepted framework for understanding primate evolution. This phylogenetic tree served as a standard reference for our study, allowing us to compare our data and draw conclusions. According to this article Order Primata is subdivided into two major Suborder Haplorrhini and Strepsirrhini. The remaining primate phylogeny is classified as follows.

**Suborder Haplorrhini** further divides into Infraorders, namely Simiiformes and Tarsiiformes. Tarsiiforme include only one Family (Tarsiidae) with only two extant species. Simiiformes is subdivided into Parvorders Catarrhini (Old world) and Platyrrhini (New world).

Parvorder Catarrhini in turn consist of the Superfamilies Cercopithecoidea and Hominoidea. Cercopithecoidea has only one extant Family *viz*. Cercopithecidae but the organisms of Superfamily Hominoidea is further divided into two Families, *viz*, Hylobatidae and Hominidae. Family Cercopithecidae has two Subfamilies such as Cercopithecinae and Colobinae. Family Hylobatidae include all Gibbon Genus and there is no further subgrouping. Hominidae on the other hand has two Subfamilies *viz.* Homininae and Ponginae. Subfamily Ponginae include all species of Orangutang and  all o there Greater Apes and Humans are included in Homininae. Subfamily Cercopithecinae is subdivided into two Tribes namely, Papionini and Cercopithecini whereas Colobinae is subdivided into two Tribes namely Presbytini and Colobini.

Parvorders Platyrrhini on the other hand is divided directly into three Families such as Cebidae, Atelidae and Pitheciidae. Family Cebidae has four Subfamilies namely, Callitrichinae, Aotinae, Cebinae and Saimirinae. Fly. Atelidae has two Subfamilies (Atelinae & Alouattinae) so also Fly. Pitheciidae (Callicebinae & Pitheciinae).

**Suborder Strepsirrhini** is divided into the Infraorders Lemuriformes, Chiromyiformes and Lorisiformes. Unlike Haplorrhini, there is no observed grouping of these Infraorders into Parvorders or Superfamilies. Instead, they are grouped into Families such as Lepilemuride,

Cheirogaleidae, Indriidae, Lemuridae, Daubentoniidae, Lorisidae and Galagidae. Further subdivision within Lorisidae includes the subfamilies Lorisinae and Perodicticinae.

**<u>MMP-</u>1**

The phylogenetic tree for the MMP1 gene in primates was meticulously constructed, employing an analysis of amino acid sequences from various primate species. To enhance our phylogenetic analysis, *Mus musculus* was strategically employed as the outgroup, providing a reference point for the evolutionary relationships within the MMP1 collagenase gene among primates. Our investigation also utilized a well established standard phylogenetic tree for primates, derived from genomic sequences across diverse species, serving as a foundational reference for elucidating the evolutionary dynamics of collagenase genes within our study group (Reference). The results obtained regarding the evolutionary pathway of the MMP1 gene include the following observations:

- *Carlito syrichta*: Our findings indicate that MMP1 gene of *Carlito syrichta,* a tarsier species primarily descended with minimal changes from the common ancestor of all primates indicating an ancient ancestry. Although this tree suggests such an ancient ancestry and early divergence of *Carlito syrichta* from the early primate stock, a comparison with the established tree reveals that tarsiers diverged from a common stock of strepsirrhini - more primitive primate. It is therefore inferred that the MMP1 gene remained with minimum changes in the tarsiers as compared to strepsirrhini primates.

- *Hominidae:* In our tree constructed using MMP1 the common ancestor of *Pan* and *Homo*, along with the common ancestor of *Gorilla* and *Pongo,* collectively share a common ancestor. Gibbons, including *Nomascus* and *Symphalangus,* share a common ancestor that along with the common ancestor of *Hominidae* were descended from a common stock of interbreeding ape like animal. Upon analysing the standard phylogenetic tree, a similar pattern emerges, with *Homo* and *Pan* sharing a common ancestor. This common ancestor was also ancestral to present day *Gorilla,* from which the *Pongo* ancestry might have diverged. However, the discrepancy in our results suggestive of *Gorilla* sharing a recent

common ancestor with *Pongo,* but not with *Homo* or *Pan*. This suggests a simultaneous origin for *Gorilla* and *Pongo*, contrary to the standard tree's assertion of *Gorilla*'s more recent evolution compared to *Pongo*. Further analysis of the amino acid sequences are required to see if the *Homo-Pan* group has any common advantage with the kind of changes on the MMP1 protein over the *Gorilla-Pongo* group.

- Old World Monkeys: Our results indicate that, three groups *viz. Macaca*, *Papio* and *Theropithecus* are equally distant from a common ancestor, while *Colobus* and *Trachypithecus* share another common ancestor. The standard phylogenetic tree confirms this, revealing a common ancestor for *Colobus* and *Trachypithecus,* along with the ancestor of *Macaca, Papio* and *Theropithecus.* But with *Macaca, Papio* and *Theropithecus,* our results differ from the standard tree. While standard tree implies that *Papio* and *Theropithecus* had a common ancestor after the common ancestry shared with *Macaca,* our tree do not mention between an ancestor common to both *Papio* and *Theropithecus.* Though the changes are minimal, it wold be interesting to look for the their sequences for further analysis.

- New World Monkeys: Our findings in New World Monkeys suggest that *Saimiri* and *Cebus* share a most recent common ancestor, while *Aotus* share a common ancestor with this lineage. This is consistent with both our phylogenetic tree and the standards phylogenetic tree. Furthermore, *Nycticebus* and *Otolemur* share a common ancestor, and *Lemur* and *Microcebus* also share a common ancestor. The common ancestors of these pairs collectively had a single common ancestor, aligning with observations on the standard phylogenetic tree.

**MMP-8**

- *Hominidae*: In the phylogenetic tree derived from MMP8 sequence data, it was observed that the common ancestor of Homo and Gorilla shares ancestry with the common ancestor of Pan. This collective ancestry is further linked to the common ancestor of Hominidae, which is shared with Gibbons. In contrast to the standard phylogenetic tree, where Pan and Homo share an ancestor ancestral to present-day Gorilla, our results suggest the potential existence of an alternative evolutionary pathway for these three species. A comprehensive investigation is recommended to explore the implications of this alternative pathway further.

- Loris: Our findings indicate that the Loris shares a common ancestor with Hominidae, Tarsier, Gibbons, New World, and Old World monkeys, all of which originate from the Strepsirrhini primates. Similarly, Lemurs are shown to arise from Haplorrhini primates. Discrepancies with the standard phylogenetic tree, which suggests a more recent common ancestry for Lemurs and Loris, necessitate further analysis to validate the proposed ancestral pattern among the descendants of these two major groups of early primates.

- New World Monkeys: Upon examining the lineage of New World monkeys, it is observed that recent descendants Aotus and Saimiri share a common ancestor, which is further linked to the common ancestor of Cebus and Sapajus. This lineage can be traced back to early Strepsirrhini primates. Although minor differences are noted compared to the standard phylogenetic tree, where an ancestor common to Saimiri and Cebus precedes the common ancestry with Aotus, further analysis is warranted to explore these nuances.

- Old World Monkeys: Our analysis reveals that Papio and Theropithecus share a common ancestor, which is connected to the common ancestor of Macaca. This ancestral lineage can be traced back to an ancestor shared with the common ancestor of Piliocolobus and Trachypithecus. The observed pattern aligns with the standard phylogenetic tree in the lineage of Old World monkeys.

**<u>MMP-13</u>**

- *Hominidae*: When we comparing the phylogenetic tree made by us on the basis of MMP13 and the standard one, the Nomascus leucogenys & Symphalongus syndactylus (Hylobatidae) share a recent common ancestor and they together share common ancestor with old world monkeys in MMP13. But, when we comparing this with the standard one we can observe that the Hylobatidae sharing common ancestor with Hominidae.
- New World Monkeys: Our findings in new world monkeys by comparing the Standard phylogenetic tree with the phylogenetic tree of MMP13 depicting that, in the phylogenetic tree of MMP13, the Cebus imitator & Sapajus apella shares a recent common ancestor and these group share a common ancestor with Samiri bolivensis and all of these collectively share a common ancestor with Aotus nancymaae. When we comparing this with the standard phylogenetic tree Cebus imitator & Samiri bolivensis directly arrived from a common ancestor.
- Old World Monkeys: By analysing the group Cercopithecidae in the tree of MMP13, Papio Anubis & Theropithecis gelada share a recent common ancestor and they together share a common ancestor with Macaca group, Piliocolobus tephrosceles & Trachypithecus francoisi directly. But when we comparing this with the standard phylogenetic tree, they where not sharing a common ancestor directly, all of them share a common ancestor with other species recently, but all of them primitively share a common ancestor.

Alignment: D:\Leyon\Evolution\MMP1\1-tree_for_seaview.txt
Seaview [blocks=10 fontsize=12 A4-landscape] on Wed Jan 31 07:26:41 2024

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                              1
Homo_sapiens                  MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Mus_musculus                  MPSLP---LL LLLWAASSYS FPVFHNGDRQ NVETVWKYLE NYYNL---GK NMQAKNVNGK EMMAEKLRQM
Aotus_nancymaae               MHSYPP-LLL LLFWGVVSHG FPATLETQEQ DVEIVQKYLE QYYNLKNDGK QVEKKRSSGP --VVEKLKQM
Carlito_syrichta              MPSLP--LVL MLLWAVGSRG FPATSETREQ DVEIVQKYLE NYFNLKNDGK QFEKQRHSAP --VVEKLKEM
Cebus_imitator                MHSYPL-LLL LLFWGVVSHG FPATLETQEQ DVEIVQKYLE QYYNLKNDGK QVEKQRNSGP --VVEKLKQM
Gorilla_gorilla               MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Lemur_catta                   MPSFS--LLL LLLWGLGSHG FPAIPETQEQ DVEIVQKYLE NYYDLKNVGK QIEKKRSSGS --VVEKLKQM
Macaca_mulatta                MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDFVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Macaca_nemestrina             MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Microcebus_murinus            MPRFS--LLL LLLWSLGSHG LPVAPETQEQ DVEIVQKYLE NYYDLKNDGK QIEKKRNSGP --VVEKLKQM
Nomascus_leucogenys           MHSFPPLLLL LLFWSVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGL --VVEKLKQM
Nycticebus_coucang            MPSF---LLL LLLWGLGSHA FPAIPEPQEQ DVEIVQKYLE NYYDLKNDGS QIERKRNSGP --VVEKLKQM
Otolemur_garnettii            MSSFP--LLL LLLWGLGSHA LPVTPETQEQ DVEIVQKYLE NYYDLKNDGM QIERKRNSGP --VVEKLKQM
Pan_paniscus                  MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Pan_troglodytes               MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Papio_anubis                  MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Piliocolobus_tephrosceles     MHSFPPLLLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVQKQRNSGP --VVEKLKQM
Pongo_abelii                  MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Pongo_pygmaeus                MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Saimiri_boliviensis           MHSYPP-LLL LLFWSVVSHG FPATLETQEQ DVEIVQKYLE QYYDLKNDGK QVEKQRNSGP --VVEKLKQM
Sapajus_apella                MHSYPL-LLL LLFWGVVSHG FPATLETQEQ DVEIVQKYLE QYYNLKNDGK QVEKQRNSGP --VVEKLKQM
Symphalangus_syndactylus      MHSFPPLLLL LLFWSVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGL --VVEKLKQM
Theropithecus_gelada          MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Trachypithecus_francoisi      MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDRR QVEKQRNSGP --VVEKLKQM
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                              71
Homo_sapiens                  QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Mus_musculus                  QQLFGLKVTG NSDPETLRAM KKPRCGVPDV APYAITHNNP RWTKTHLTYS ILNYTPYLPK AVVEDAIARA
Aotus_nancymaae               QEFFGLKVTG KPDAETLNVM KQPRCGVPDV ARFVLTEGNP RWEKTHLTYR IENYTPDLPR ADVDQAIEKA
Carlito_syrichta              QKFFGLKVTG KPDPETLKVM KQPRCGVPDV AQFVLTEGNP RWQKTDLTYR IENYTPDLPK AEVDRAIEKA
Cebus_imitator                QEFFGLKVTG KPDAETLKVM KQPRCGVPDV ARFVLTEGNP RWKKTHLTYR IENYTPDLPR SDVDHAIEKA
Gorilla_gorilla               QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Lemur_catta                   QEFFGLKVTG KPDTETLKVM KQPRCGVPDV ARFVLTQGNP RWEQTHLTYR IENYTPDLPR ADVDLAIEKA
Macaca_mulatta                QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR AAVDQAIEKA
Macaca_nemestrina             QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR AAVDQAIEKG
Microcebus_murinus            QEFFGLKVTG KPDTETLKVM KQPRCGVPDV ARFVLTQGNP RWEKTHLTYR IENYTPDLSR ADVDHAIEKA
Nomascus_leucogenys           QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTAGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Nycticebus_coucang            QEFFGLKVTG TPDTETLKVM KQPRCGVPDV ARFALTPGNP RWEQTHLTYR IENYTPDLPR ADVDDAIEKA
Otolemur_garnettii            QEFFGLKVTG TPDTETLKVM KQPRCGVPDV ARFVLTQGNP RWEQTHLTYR IENYTPDLPK ADVDDAIEKA
Pan_paniscus                  QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIAKA
Pan_troglodytes               QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIAKA
Papio_anubis                  QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR AAVDQAIEKA
Piliocolobus_tephrosceles     QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDRAIEKA
Pongo_abelii                  QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Pongo_pygmaeus                QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Saimiri_boliviensis           QEFFGLKVTG KPDAETLNVM KQARCGVPDV ARFVLTEGNP RWEKTHLTYR IENYTPDLRR ADVDHAIEKA
Sapajus_apella                QEFFGLKVTG KPDAETLKVM KQPRCGVPDV ARFVLTEGNP RWEKTHLTYR IENYTPDLPR SDVDHAIEKA
Symphalangus_syndactylus      QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTAGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Theropithecus_gelada          QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR AAVDQAIEKA
Trachypithecus_francoisi      QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDRAIEKA
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                              141
Homo_sapiens                  FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Mus_musculus                  FRVWSDVTPL TFQRVFEEEG DIVLSFHRGD HGDNNPFDGP NYKLAHTFQP GPGLGGDVHY DLDETWTNSS
Aotus_nancymaae               FQLWSNVTPL TFTKVPKGQA DIMISFVRGD HQDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDETWTNNF
Carlito_syrichta              FQLWSNASPL RFTKVVEGQA DIMISFVRGD HQDNSPFYGP GENLAHAFQP GPNIGGDAHF DEDETWTNNI
Cebus_imitator                FQLWSNVTPL TFTKVPKGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GSGIGGDAHF DEDETWTNNF
Gorilla_gorilla               FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Lemur_catta                   FQLWSNASPL TFTKVFEGQA DIMISFVRGD HQDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDEQWTSDS
Macaca_mulatta                FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Macaca_nemestrina             FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Microcebus_murinus            FQLWSNASPL TFTRVFEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDEQWTNNF
Nomascus_leucogenys           FKLWSNVTPL TFTKVSEGQA DIMISFVRGD HQDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Nycticebus_coucang            FRLWSNASPL TFTKVFQGQA DIMISFVRGD HQDNSPFDGP GGNLAHAFQP GPGIGGDTHF DEDERWTNNL
Otolemur_garnettii            FQLWSNASPL TFTKVFQGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDEKWTNNL
Pan_paniscus                  FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Pan_troglodytes               FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Papio_anubis                  FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Piliocolobus_tephrosceles     FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Pongo_abelii                  FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Pongo_pygmaeus                FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Saimiri_boliviensis           FQLWSNVTPL TFTKVPKGQA DIMISFVRGD HQDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDETWTNNF
Sapajus_apella                FQLWSNVTPL TFTKVPKGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDETWTNNF
Symphalangus_syndactylus      FKLWSDVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DDDERWTNNF
Theropithecus_gelada          FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Trachypithecus_francoisi      FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
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Homo_sapiens                  REYNLHRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Mus_musculus                  ENFNLFYVTA HELGHSLGLT HSSDIGALMF PSYTWYTEDF VLNQDDINRI QDLYGPSPNP IQPTGATTPH
Aotus_nancymaae               REYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGKSQNP VQPTGPQTPQ
Carlito_syrichta              QNYNLYRVAA HEFGHSLGLS HSTDIGALMY PTYT-YSGDV QLAQDDIDGI QAIYGPSQNP IQPTGPQTPQ
Cebus_imitator                RGYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGQSPNP VQPTGPQTPQ
Gorilla_gorilla               REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Lemur_catta                   RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYT-FSGDV QLAQDDIDGI QAIYGPSQNP NQPTGPQTPQ
Macaca_mulatta                REYNLYRVAA HEFGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Macaca_nemestrina             REYNLYRVAA HELGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Microcebus_murinus            RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYA-FSGDV QLAQDDIDGI QAIYGPSQNP NQPIGPQTPQ
Nomascus_leucogenys           REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Nycticebus_coucang            RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYA-FSGEV ELAQDDIDGI QAIYGPSQNP IQPIGPQTPQ
Otolemur_garnettii            RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYA-FSGEV ELAQDDIDGI QAIYGPSQNP VQPTGPQTPQ
Pan_paniscus                  REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGHSQNP VQPIGPQTPK
Pan_troglodytes               REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Papio_anubis                  REYNLYRVAA HELGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Piliocolobus_tephrosceles     REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLSQDDIDGI QAIYGGSQNP VQPTGPQTPK
Pongo_abelii                  REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGPSQNP VQPIGPQTPK
Pongo_pygmaeus                REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGPSQNP VQPIGPQTPK
Saimiri_boliviensis           REYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGPSPNP VQPTGPQTPQ
Sapajus_apella                REYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGQSPNP VQPTGPQTPQ
Symphalangus_syndactylus      REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Theropithecus_gelada          REYNLYRVAA HELGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Trachypithecus_francoisi      REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
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                            281
Homo_sapiens                ACDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Mus_musculus                PCNGDLTFDA ITTFRGEVFF FKGRFYIRVN RFMPEPELNL IGILWPNLPV KLDAAYEASM IDQVRYFKGS
Aotus_nancymaae             VCDSKLTFDA ITTIRGEVFF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Carlito_syrichta            ACDSKISFDA VTTIRGEVMF FKDRFFMRTH PSYPEADLNF ISDFWPLLPN GLEAAYEDAG RDQVRFFKGY
Cebus_imitator              VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PYYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Gorilla_gorilla             VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLQAAYEFAD RDEVRFFKGN
Lemur_catta                 VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPS GLEAAYEVAS RDEVRFFKGN
Macaca_mulatta              VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Macaca_nemestrina           VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Microcebus_murinus          VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF VSVFWPQLPT GLEAAYEVAD RDEVRFFKGN
Nomascus_leucogenys         VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Nycticebus_coucang          VCDSKLTFDA VTTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPS GLEAAYEVVD RDEIRFFKGN
Otolemur_garnettii          VCDSKLTFDA VTTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEVAD RDEVRFFKGN
Pan_paniscus                VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PSYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Pan_troglodytes             VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Papio_anubis                VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Piliocolobus_tephrosceles   VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLQAAYEFAE RDEVRFFKGN
Pongo_abelii                VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Pongo_pygmaeus              VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Saimiri_boliviensis         VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Sapajus_apella              VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PYYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Symphalangus_syndactylus    VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGK
Theropithecus_gelada        VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Trachypithecus_francoisi    VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLQAAYEFAD RDEVRFFKGN
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                            351
Homo_sapiens                KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Mus_musculus                KVWAVQEQSV LRGFPRDIHS FFGFPSNVTH IDAAVCEEET GKTYFFVDHM YWRYDENTQS MDPGYPRLTA
Aotus_nancymaae             KYWAAQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDAGYPKMIA
Carlito_syrichta            RFWAVQGQDV LRGYPQDIYS SYGFPRTVKH IDAAVFEEET GKTFFFVGNK YWRYDEYKRS MDVGYPKMIA
Cebus_imitator              KYWAVQGQNV LYGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDAGYPKKIA
Gorilla_gorilla             KYWAVQGQNM LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDPGYPKMIA
Lemur_catta                 KYWAVQGQNV LPGYPKDIYR SFGFPRTVKH IDAAISEEDT GKTYFFVANK YWRYDEYKQS MDTGYPKKLA
Macaca_mulatta              KYWAVQGQNV LPGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Macaca_nemestrina           KYWAVQGQNV LPGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Microcebus_murinus          KYWAVQGQNV LPGYPKDIYK SFGFPKTVKH IDAAVSEEDT GKTYFFVANK YWRYDEYKQS MDAGYPKMIA
Nomascus_leucogenys         KYWAVQGQNV LHGYPKDIYS SFGFPRTVKR INAALSEENT GKTYFFVAKK YWRYDEYKRS MDPGYPKMIA
Nycticebus_coucang          KYWAVRGQDV LHGYPKDISS SFGFPRTVKH VDAAVSEEET GKTYFFVANK YWRYDENKQS MDTGYPKMIA
Otolemur_garnettii          KYWAVRGPDV LHGYPKDISS SFGFPRTVKH VDAAVSEEET GKTYFFVANK YWRYDENKQS MDTGYPKTIA
Pan_paniscus                KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Pan_troglodytes             KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Papio_anubis                KYWAVQGQNV LPGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIS
Piliocolobus_tephrosceles   KYWAVQGQNV LRGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Pongo_abelii                KYWAVQGQNM LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEHKRS MDPGYPKMIA
Pongo_pygmaeus              KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Saimiri_boliviensis         KYWAVQGQNV LYGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDAGYPKMIA
Sapajus_apella              KYWAVQGQNV LYGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDAGYPKKIA
Symphalangus_syndactylus    KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVAKK YWRYDEYKRS MDPGYPKMIA
Theropithecus_gelada        KYWAVQGQNV LPGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK CWRYDEYKRS MDPGYPKMIA
Trachypithecus_francoisi    KYWAVQGQNV LRGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYERS MDPGYPKMIA
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Homo_sapiens                  HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Mus_musculus                  EDFPGIDDKV DDVFQKGENF YFFHQSVQHR FNLQIRRVDD SRDSSTWFNC ---
Aotus_nancymaae               DDFPGIGHKV DAVFMKDGFF YFFHKTRQYK FEPETKRILT LQKANSWFNC RKN
Carlito_syrichta              HGFPGIGHKV DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKN
Cebus_imitator                HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Gorilla_gorilla               HDFPGIGHKV DAVFMKDGFF YFFRGRRQYK FDPETKRILT LQKANSWFNC RKN
Lemur_catta                   LDFPGIGHKI DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKK
Macaca_mulatta                HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Macaca_nemestrina             HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Microcebus_murinus            HDFPGIGHKI DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKN
Nomascus_leucogenys           HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Nycticebus_coucang            HDFPGIGHKV DAVFKKDEFF YFFHGTRQYK FDLKTKRILT LLKANSWFNC RKH
Otolemur_garnettii            HDFPGIGHKV DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKH
Pan_paniscus                  HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Pan_troglodytes               HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Papio_anubis                  HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Piliocolobus_tephrosceles     HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Pongo_abelii                  HDFPGIGHKV DAVFTKDGFF YFFHGTRQYK FDPETKRILT LQKANSWFNC RKN
Pongo_pygmaeus                HDFPGIGHKV DAVFTKDGFF YFFHGTRQYK FDPETKRILT LQKANSWFNC RKN
Saimiri_boliviensis           HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Sapajus_apella                HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Symphalangus_syndactylus      HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Theropithecus_gelada          HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Trachypithecus_francoisi      HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
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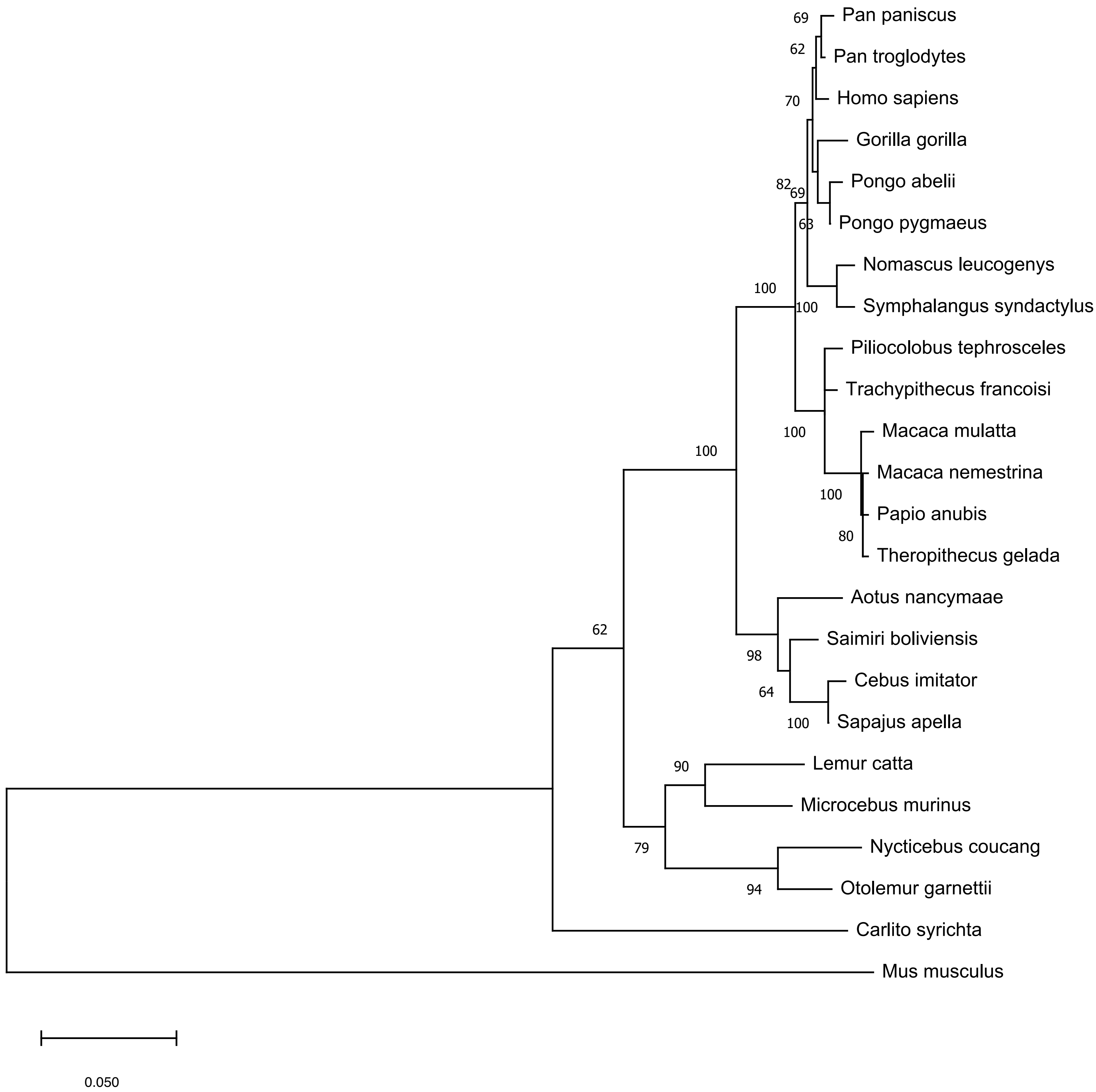
Pan paniscus
Pan troglodytes
Homo sapiens
Gorilla gorilla
Pongo abelii
Pongo pygmaeus
Nomascus leucogenys
Symphalangus syndactylus
Piliocolobus tephrosceles
Trachypithecus francoisi
Macaca mulatta
Macaca nemestrina
Papio anubis
Theropithecus gelada
Aotus nancymaae
Saimiri boliviensis
Cebus imitator
Sapajus apella
Lemur catta
Microcebus murinus
Nycticebus coucang
Otolemur garnettii
Carlito syrichta
Mus musculus
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Mus_musculus                  MFRLKTLPLL IFLHTQLANA FPVPEHLEEK NIKTAE---- -------NYLR KFYNLPSNQF RSSRN--ATM
Aotus_nancymaae               MFCLKTLPFL LLLHVQISKA FPVSS--KEK DTKIVQ---- -------DYLE KFYQLPSNQY QSIRKNSINM
Carlito_syrichta              MFSLQMLLFL LLLHMQVATA FPTPS--EEK STTMVQ---- -------DYLE KFYQLPSSRY RSARKNSTSM
Cebus_imitator                MFCLKTLPFL LLLHVQISKA FPVSS--KEK DTKIVQ---- -------DYLE KFYQLPSNQH QSIRKNSINM
Gorilla_gorilla               MFSLKTLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Lemur_catta                   MFYLKTLPFL LLLHMELSKA FPVPS--EEK NAKIVQ---- -------DYLE KFYRLPSNQY RTARKNSPST
Macaca_mulatta                MFSLKMLLFL LLLHVQISKA FPVSS--KEE NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTSM
Macaca_nemestrina             ---------- -------MQQ IP-------- QEKSIN---- -------DYLE KFYQLPSNQY QSTRKNGTSM
Microcebus_murinus            MFCLKTLPLL LLLHMELSKA FPVPS--EGR NAKIVQ---- -------DYLE KFYRLPSNQY RTARKNSASM
Nomascus_leucogenys           MFALKTLPFL LLLHVHISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Nycticebus_coucang            MFCLKTLLFL LLLHVQLSKT FPVVS--AEK NTKLIQ---- -------DYLE KFYQLPSNRY RTSRKNSTTM
Otolemur_garnettii            MFRLKTLVFL LLLHVPLSKT FPVVS--AEK NTKLIQ---- -------DYLE KFYQLPSNRY RTSRKNSTTM
Pan_paniscus                  MFSLKTLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Pan_troglodytes               MFSLKMLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Papio_anubis                  MFSLKMLPFL LLLHVQISKA FPVSS--KEE NTKIVQ---- -------DYLE KFYQLPSNQY QSMRKNGTSM
Piliocolobus_tephrosceles     MFSLKTLPFL FLLHVQISKA FPVSS--KEE NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTSM
Pongo_abelii                  MFSLKTLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Pongo_pygmaeus                -MCRFPRPFL YLLKRKIQKL FSTRP--SQK PTRCSHLILD FPASKIDYLE KFYQLPSNQY QSTRKNGTNV
Saimiri_boliviensis           MFCLKRLPFL LLLHVQISKA FPVSF--KEK DTKIVQ---- -------DYLE KFYQLPSNQY QSIRKNSINM
Sapajus_apella                MFCLKTLPFL LLLHVQISKA FPVSS--KEK DTKIVQ---- -------DYLE KFYQLPSNQY QSIRKNSINM
Symphalangus_syndactylus      MFALKTLPFL LLLHVHISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Theropithecus_gelada          MFSLKMLPFL LLLHVQISKA FPVSS--KEE NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTSM
Trachypithecus_francoisi      MFSLKTLPFL LLLHVQISKA FPLSS--KEE NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTSM
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                              71
Homo_sapiens                  IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGG FMLTPGNPKW ERTNLTYRIR NYTPQLSEAE
Mus_musculus                  VAEKLKEMQR FFSLAETGKL DAATMGIMEM PRCGVPDSGD FLLTPGSPKW THTNLTYRII NHTPQLSRAE
Aotus_nancymaae               IVEKLKEMQR FFGLNVTGKP NAETLEMMKQ PRCGVPDSGD FMITPGNPKW EQTNLTYRII NYTPQLSETE
Carlito_syrichta              IVEKLKEMQR FFGLNVTGKP DAETLETMEK PRCGVPDRGD FMLTPGNPKW KHTNLTYRII NYTPQLSEAD
Cebus_imitator                IVEKLKEMQQ FFGLNVTGKP NAETLEMMKQ PRCGVPDSGD FMITPGNPKW EQTNLTYRII NYTPQLSETE
Gorilla_gorilla               IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGG FMLTPGNPKW EHTNLTYRIR NYTPQLSVAE
Lemur_catta                   IVEKLKEMQR FFRLNVTGKP DAETLEVMEK PRCGVPDSGD FAITPGNPKW EHTNLTYRII SYTQQLSEAD
Macaca_mulatta                IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMLTPGNPKW ERTNLTYSIL NYTPQLSETD
Macaca_nemestrina             IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMLTPGNPKW ERTNLTYSIL NYTPQLSETD
Microcebus_murinus            VVEKLKEMQR FFGLNVTGKP DAETLEVMEK PRCGVPDSSS FMITPGSPKW EHTNVTYRII SHTQQLSVAE
Nomascus_leucogenys           IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMITPGNPKW ERTNLTYRIR NYTPQLSKAD
Nycticebus_coucang            IVEKLKEMQR FFGLNVTGKP NAETLEMMEK PRCGVPDTAG FVLTPGNPKW EHINLTYRFI NYTPQLSKTD
Otolemur_garnettii            IVEKLKEMQR FFGLNVTGKP NAETLEMMEK PRCGVPDTAG FMLTPGSPKW EHTNLTYRFI NYTPQLSKTD
Pan_paniscus                  IIEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGG FMLTPGNPKW ERTNLTYRIR NYTPQLSEAE
Pan_troglodytes               IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGG FMLTPGNPKW EHTNLTYRIR NYTPQLSEAE
Papio_anubis                  IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMLTPGNPKW EHTNLTYRIL NYTPQLSETD
Piliocolobus_tephrosceles     IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDTGD FMLTPGNPKW KHTNLTYSIL NYTPQLSQTD
Pongo_abelii                  IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGE FMLTPGNPKW ERTNLTYRIR NYTPQLSEDD
Pongo_pygmaeus                IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGE FMLTPGNPKW ERTNLTYRIR NYTPQLSEDD
Saimiri_boliviensis           IVEKLKEMQR FFGLNVTGKP DAETLEMMKQ PRCGVPDSGD FMITPGNPKW EQTNLTYRFI NYTPQLSVTE
Sapajus_apella                IVEKLKEMQQ FFGLNVTGKP NAETLEMMKQ PRCGVPDSGD FMITPGNPKW EQTNLTYRII NYTPQLSETE
Symphalangus_syndactylus      IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMITPGNPKW ERTNLTYRIR NYTPQLSKTD
Theropithecus_gelada          IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMLTPGNPKW ERTNLTYRIL NYTPQLSETD
Trachypithecus_francoisi      IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDTGD FMLTPGNPKW KHTNLTYSIL NYTPQLSKTD
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                          141
Homo_sapiens              VERAIKDAFE LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Mus_musculus              VKTAIEKAFH VWSVASPLTF TEILQGEADI NIAFVSRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDS
Aotus_nancymaae           VETAIGNAFK VWSNASSLTF TRISQGEANI SIAFFHRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDA
Carlito_syrichta          VDSAIERAFE LWSHASPLRF TRISQGEPDI KIAFVQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Cebus_imitator            VERAIGDAFK VWSDVSPLTF TRISQGEADI NIAFYQKDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Gorilla_gorilla           VERAIKDAFE LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Lemur_catta               VETAIEKAFK VWSDVSPLTF TRISRGEADI KIAFYLRDHG DNSPFDGPNG ILAHAFQPGR GIGGDVHFDA
Macaca_mulatta            VEGAIKKAFE VWSKASPLTF TRISQGQADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Macaca_nemestrina         VEGAIKKAFE VWSKASPLTF TRISQGQADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Microcebus_murinus        VGAAFEKAFK LWSGASPLTF TRISQGEADI KIAFVQRDHG DNSPFDGPNG ILAHAFQPGP GIGGDVHFDA
Nomascus_leucogenys       VERAIEKAFK VWSDASPLTF TRISQGEADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Nycticebus_coucang        VETVIEKAFE VWSKASPLTF TKISQGEADI KIAFVRREHG DNSPFDGPNG ILAHAFQPGR GIGGDVHFDE
Otolemur_garnettii        VETVIEKAFE VWSKASPLTF TKTAQGEADI KIAFVQKDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDE
Pan_paniscus              VERAIKDAFK LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Pan_troglodytes           VERAIKDAFE LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Papio_anubis              VEGAIKKAFE VWSKASPLTF TRISQGQADI NIGFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Piliocolobus_tephrosceles VEGTIKKAFE VWSKVSPLTF TRISQGDADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Pongo_abelii              VKTAIEKAFE VWSKASPLTF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDA
Pongo_pygmaeus            VKTAIEKAFE VWSKASPLTF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDA
Saimiri_boliviensis       VETAIGNAFK IWSDPSPLTF TRISQGEADI NIAFFPRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Sapajus_apella            VETAIGDAFK VWSDVSPLTF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Symphalangus_syndactylus  VERAIEKAFK VWSDASPLTF TRISQGEADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Theropithecus_gelada      VEGAIKKAFE VWSKASPLTF TRISQGQADI NIGFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Trachypithecus_francoisi  IEGAIKKAFE VWSKVSPLTF TRISQGEADI NIGFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
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Homo_sapiens               EETWTNTSAN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDIDGIQ AIYGLSSNPI
Mus_musculus               EETWTQDSKN YNLFLVAAHE FGHSLGLSHS TDPGALMYPN YAYREPSTYS LPQDDINGIQ TIYGPSDNPI
Aotus_nancymaae            EETWTSTSKN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYS LPQDDINGIQ AIYGPSSNPI
Carlito_syrichta           EETWTKTSAN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYL LPQDDINGIQ AIYGPSDNPI
Cebus_imitator             EETWTNTSEN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYS LPQDDINGIQ AIYGPSSNPI
Gorilla_gorilla            EETWTNTSAS YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDIDGIQ AIYGLSSNPI
Lemur_catta                EETWTTNANN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFREPSTYT LPQDDINGIQ AIYGPSSNPV
Macaca_mulatta             EETWTKTSTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Macaca_nemestrina          EETWTKNSTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Microcebus_murinus         EETWTTNFNN YNLFLVAAHE FGHSLGLAHS SDAGALMYPN YAFSEPSTYT LPQDDINGIQ AIYGPSNNPI
Nomascus_leucogenys        EETWTKTSTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSTYS LPQDDIDGIQ AIYGPSSNPI
Nycticebus_coucang         EETWTTTAVN YNLFLVAAHE FGHSLGLSHS TDPGALMYPN YAFNDPSTYS LPQDDINGIQ AIYGPSSSPV
Otolemur_garnettii         EETWTTTSIN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFNEPSTYS LPQDDINGIQ AIYGPSNSPV
Pan_paniscus               EETWTDTSAN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDIDGIQ AIYGLSSNPI
Pan_troglodytes            EETWTDTSAN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDIDGIQ AIYGLSSNPI
Papio_anubis               EETWTKDFTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Piliocolobus_tephrosceles  EETWTTNSTN YNLFLVAAHE FGHSLGLAHS FDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Pongo_abelii               EETWTKTSAN YNLFIVAAHE FGHSLGLAHS SDPGALMYPN YAFTETSNYS LPQDDIDGIQ AIYGPSSNPV
Pongo_pygmaeus             EETWTKTSAN YNLFIVAAHE FGHSLGLAHS SDPGALMYPN YAFTETSNYS LPQDDIDGIQ AIYGPSSNPV
Saimiri_boliviensis        EETWTSTSEN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYS LPQDDINGIQ AIYGPSSNPI
Sapajus_apella             EETWTNTPEN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYS LPQDDINGIQ AIYGPSSNPI
Symphalangus_syndactylus   EETWTKTSAN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSTYS LPQDDIDGIQ AIYGPSSNPI
Theropithecus_gelada       EETWTKDFTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Trachypithecus_francoisi   EETWTTNSTN YNLFLVAAHE FGHSLGLAHS FDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
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                              281
Homo_sapiens                  QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Mus_musculus                  QPTGPSTPKA CDPHLRFDAT TTLRGEIYFF KDKYFWRRHP QLRTVDLNFI SLFWPFLPNG LQAAYEDFDR
Aotus_nancymaae               QPTGPSTPRP CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Carlito_syrichta              QPTGPSTPRT CDPRLTFDAI TTLRGEIFFF RDKYFWRRHP QLRSIEFNFI SLFWPALPDS IQAAYEDLDR
Cebus_imitator                QPTGPSTPRP CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Gorilla_gorilla               QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Lemur_catta                   QPTGPSTPRS CDPRLTFDAI TTLRGEILFF KDKYFWRRHP QLRSVELNFI SLFWPNLPNG IQAAYEDFDR
Macaca_mulatta                QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Macaca_nemestrina             QPTGPTTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Microcebus_murinus            QPTGPSTPMA CDPRLTFDAI TTLRGEIFFF KDKYFWRRHP QLRSVELNFI SLFWPSLPNG IQAAYEDFDK
Nomascus_leucogenys           QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDSDR
Nycticebus_coucang            QPTGPSTPRT CDPRLTFDAI TTLRGEILFF KDKYFWRKHP QLPTVELNFI SLFWPSLPNG IQAAYEDFDR
Otolemur_garnettii            QPTGPSTPRT CDPRLTFDAI TTLRGEILFF KDKYFWRKHP QLPTAELNFI SLFWPSLPNG IQAAYEDFER
Pan_paniscus                  QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Pan_troglodytes               QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Papio_anubis                  QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Piliocolobus_tephrosceles     QPTGPSTPES CDPRLTFDAI TTLRGEILFF KDEYFWRRHP WLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Pongo_abelii                  QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRIEMNFI SLFWPSLPTG MQAAYEDFDR
Pongo_pygmaeus                QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRIEMNFI SLFWPSLPTG MQAAYEDFDR
Saimiri_boliviensis           QPTGPSTPRS CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLRRVEMNFI SLFWPSLPTG IQAAYEDFDR
Sapajus_apella                QPTGPSTPRP CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Symphalangus_syndactylus      QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Theropithecus_gelada          QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Trachypithecus_francoisi      QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
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                              351
Homo_sapiens                  DLIFLFKGNQ YWALSGYDIL QGYPKDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Mus_musculus                  DLVFLFKGRQ YWALSGYDLQ QGYPRDISNY GFPRSVQAID AAVSYNGKTY FFINNQCWRY DNQRRSMDPG
Aotus_nancymaae               DLVFLFKGNQ YWALSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Carlito_syrichta              DLVFLFKGNQ YWAMNGYDLQ PGYPRDISNY GFPSNVQAID AAVYFRSKTY FFVNDQFWRY DNERQTMEPG
Cebus_imitator                DLVFLFKGNQ YWALSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQLMEPG
Gorilla_gorilla               DLIFLFKGNQ YWALSGYDIL QGYPKDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Lemur_catta                   DLVFLFKGNQ YWALSGYDIQ QGYPRYISNY GFPSTVQAID AAVSYGSETY FFVNDQFWRY DNQRQAMDPG
Macaca_mulatta                DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Macaca_nemestrina             DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Microcebus_murinus            DLVFLFKGNQ YWAMSGYDIQ QGYPRHISNY GFPSNVQAID AAVSYGRKTY FFVNDQLWRY DNQRQAMDPG
Nomascus_leucogenys           DLIFLFKGNQ YWALSGYDIQ QGYPKSISNY GFPCSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Nycticebus_coucang            DLVFLFKGNQ YWALNGYDIQ EGYPRDISNY GFPSTVQAID AAVSYRRKTY FFVNDQFWRY DNQRQLMEPG
Otolemur_garnettii            DLVFLFKGNQ YWALNGYEIQ QGYPRDISNY GFPSTVQAVD AAVFYRRKTY FFVNDQFWRY DNQRQFMEPG
Pan_paniscus                  DLIFLFKGNQ YWALSGYDIL QGYPKDIANY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Pan_troglodytes               DLIFLFKGNQ YWALSGYDIL QGYPKDIANY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Papio_anubis                  DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Piliocolobus_tephrosceles     DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Pongo_abelii                  DLIFLFKGNQ YWALSGYDIL QGYPKNISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Pongo_pygmaeus                DLIFLFKGNQ YWALSGYDIL QGYPKNISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Saimiri_boliviensis           DLVFLFKGNQ YWALSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYKSKTY FFVNDQFWRY DNQRQFMEPG
Sapajus_apella                DLVFLFKGNQ YWALSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQLMEPG
Symphalangus_syndactylus      DLIFLFKGNQ YWALSGYDIQ QGYPKSISNY GFPCSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Theropithecus_gelada          DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Trachypithecus_francoisi      DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
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Homo_sapiens                      YPKSISGAFP GIESKVDAVF QQEHFFHVFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
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Aotus_nancymaae                   YPQSISYIFP GIESKVDAVF QQEHFFLFFS GPLYYAFDLS AQRVTRVARG NKWLNCR--
Carlito_syrichta                  YPKSTLSIFP GIESKVDAVF QQNYFFFFFS GPRFYAFDLQ AHRVTRVDRS NRWLNCR--
Cebus_imitator                    YPQRISDIFP GIERKVDAVF QQEHFFLFFS GPIYYAFDLS AQRVTRVARG NKWLNCR--
Gorilla_gorilla                   YPKSISGAFP GIESKVDAVF QQQHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Lemur_catta                       YPQSILRTFP GIQSKVDAVF QKDDFFLFFS GPLYYAFNLS TRRVTRIDRS NKWLNCR--
Macaca_mulatta                    YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Macaca_nemestrina                 YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Microcebus_murinus                YPQSISSTFP GIQSRVDAVF QQDDFFLFFS GPRYYAFNLS TNRVTRLDKS NKWLNCR--
Nomascus_leucogenys               YPKSISGTFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVERG NKWLNCRYG
Nycticebus_coucang                YPKSLSTAFP GIESRVDAVF QRDYVFLFFS GPRYYAFDLN TRRVIRIDRS NIWLNCR--
Otolemur_garnettii                YPKSISTAFP GIESRVDAVF HRDYVFVFFS GPRYYAFDLN TRRVIRIDRS NKWLNCR--
Pan_paniscus                      YPKSISGAFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Pan_troglodytes                   YPKSISGAFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Papio_anubis                      YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Piliocolobus_tephrosceles         YPKSTSGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTTVARA NEWLNCRYS
Pongo_abelii                      YPKSISDTFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Pongo_pygmaeus                    YPKSISDTFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCR--
Saimiri_boliviensis               YPQSISGIFP GIESKVDAVF QQEHFFLFFS GPIYYAFDLS AQRVTKIARG NKWLNCR--
Sapajus_apella                    YPQRISDIFP GIERKVDAVF QQEHFFLFFS GPIYYAFDLS AQRVTRVARG NKWLNCR--
Symphalangus_syndactylus          YPKSISDTFP GIESKVDAVF QQERFFLFFS GPRYYAFDLI AQRVTRVERG NKWLNCRYG
Theropithecus_gelada              YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Trachypithecus_francoisi          YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
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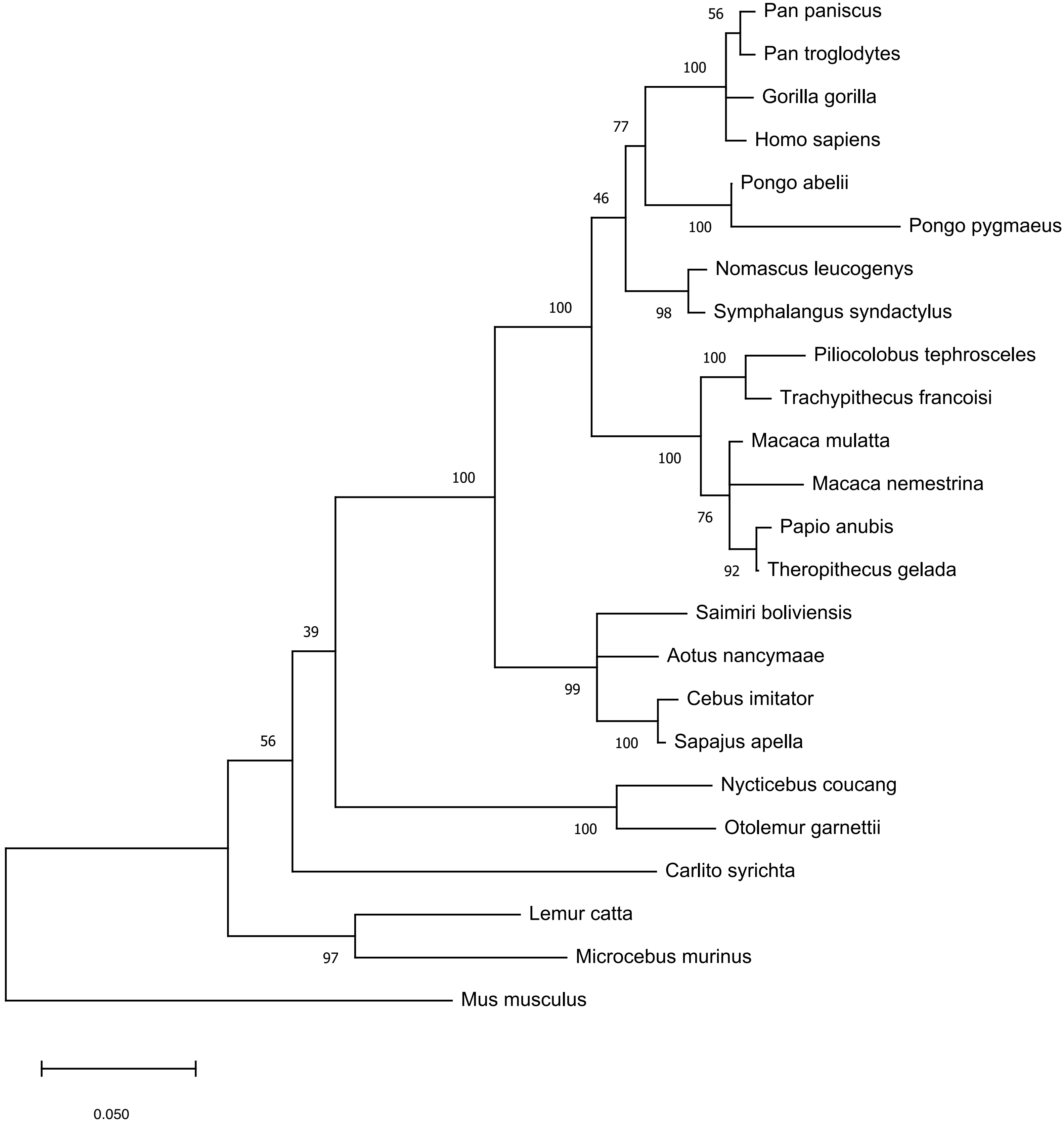

Pan paniscus
Pan troglodytes
Gorilla gorilla
Homo sapiens
Pongo abelii
Pongo pygmaeus
Nomascus leucogenys
Symphalangus syndactylus
Piliocolobus tephrosceles
Trachypithecus francoisi
Macaca mulatta
Macaca nemestrina
Papio anubis
Theropithecus gelada
Saimiri boliviensis
Aotus nancymaae
Cebus imitator
Sapajus apella
Nycticebus coucang
Otolemur garnettii
Carlito syrichta
Lemur catta
Microcebus murinus
Mus musculus
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Mus_musculus                  MHSAILATFF LLSWTPCWSL PLPYGDDDDD DLSEEDLVFA EHYLKSYYHP ATLAGILKKS TVTSTVDRLR
Aotus_nancymaae               MHLGVLAAFL FLNWTHCRAL PLPNG-DDED DLSEEDLQFA ERYLKLYYHP TNLAGILKKN SANSMADRLR
Carlito_syrichta              MHPGVLTAFL LLCWTQCQSL PLPNG-EDED DTSEEDLQFA ERYLRSFYHP VNLAGILKKN AASSMVDRLR
Cebus_imitator                MHPGVLAAFL FLSWTHCWAL PLPNG-DDED DLSEEDLQFA ERYLKLYYHP TNLAGILKKN SASSMTDRLR
Gorilla_gorilla               MHPGVLAAFL FLSWTHSRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Lemur_catta                   MHPGILVAFL FLSWTHCRSL PLPNG--DDD DLSEEDLQFA ERYLKSYYHP PNLAGILKET SASSMVDRLR
Macaca_mulatta                MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Macaca_nemestrina             MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Microcebus_murinus            -MQGVLVAFL FLSWTHCRSL PLPDG--DDD DLSEEDLQFA ERYLKSYYHP PILAGILKKT SASSMVDRLR
Nomascus_leucogenys           MHPGILAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Nycticebus_coucang            MLPGVLLAFL FLSWTHCRAL PLPND-DDDD DLSEEDLQFA ERYLKSYYYP PNLAGILKKT SASSMIDRLR
Otolemur_garnettii            MLPRVLLAFL FLSWTPCRAL PLPNG--DDD DLSEEDLQFA EHYLKSYYHP LNLAGILKKT SASSMIDRLR
Pan_paniscus                  MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTERLR
Pan_troglodytes               MHPGVLAAFL FLSWAHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTERLR
Papio_anubis                  MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Piliocolobus_tephrosceles     MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Pongo_abelii                  MHPGVLAAFL FLSWTHCRAL PLPSD-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Pongo_pygmaeus                MHPGVLAAFL FLSWTHCRAL PLPSD-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Saimiri_boliviensis           MHPGVLAAFL FLSWTHCRAL PLPNG-DDED DLSEEDLQFA ERYLKLYYHP TNLAGILKKN SASSMTDRLR
Sapajus_apella                MHPGVLAAFL FLSWTHCWAL PLPNG-DDED DLSEEDLQFA EHYLKLYYHP TNLAGILKKN SASSMTDRLR
Symphalangus_syndactylus      MHPGILAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Theropithecus_gelada          MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Trachypithecus_francoisi      MHPVVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
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Homo_sapiens                  EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Mus_musculus                  EMQSFFGLEV TGKLDDPTLD IMRKPRCGVP DVGEYNVFPR TLKWSQTNLT YRIVNYTPDM SHSEVEKAFR
Aotus_nancymaae               EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Carlito_syrichta              EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIENYTPDM PHSEVEKAFK
Cebus_imitator                EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWPKMNLT YRIVNYTPDM THSEVEKAFK
Gorilla_gorilla               EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Lemur_catta                   EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWTQTNLT YRIVNYTPDM PHSEVEKAFK
Macaca_mulatta                EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Macaca_nemestrina             EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Microcebus_murinus            EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWTQTNLT YRIVNYTPDM THSEVEKAFK
Nomascus_leucogenys           EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Nycticebus_coucang            EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWTKTNLT YRIVNYTPDM THSEVEKAFK
Otolemur_garnettii            EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWTKTNLT YRIVNYTPDM THSEVEKAFK
Pan_paniscus                  EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Pan_troglodytes               EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Papio_anubis                  EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Piliocolobus_tephrosceles     EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Pongo_abelii                  EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Pongo_pygmaeus                EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Saimiri_boliviensis           EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWSRMNLT YRIVNYTPDM THSEVEKAFK
Sapajus_apella                EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWPKMNLT YRIVNYTPDM THSEVEKAFK
Symphalangus_syndactylus      EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Theropithecus_gelada          EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Trachypithecus_francoisi      EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWSKVNLT YRIVNYTPDM THSEVEKAFK
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Mus_musculus                KAFKVWSDVT PLNFTRIYDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Aotus_nancymaae             KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Carlito_syrichta            KAFKVWSDVT PLNFTRMHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Cebus_imitator              KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Gorilla_gorilla             KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Lemur_catta                 KAFKVWSDVT PLNFTRLHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Macaca_mulatta              KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Macaca_nemestrina           KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Microcebus_murinus          KAFKVWSDVT PLNFTRLHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNLGGDA HFDDDETWTS
Nomascus_leucogenys         KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Nycticebus_coucang          KAFKVWSDVT PLNFTRLHDG TADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Otolemur_garnettii          KAFKVWADVT PLNFTRLHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pan_paniscus                KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pan_troglodytes             KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Papio_anubis                KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Piliocolobus_tephrosceles   KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pongo_abelii                KAFKVWSDVT PLNFTRLHNG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pongo_pygmaeus              KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Saimiri_boliviensis         KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Sapajus_apella              KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Symphalangus_syndactylus    KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Theropithecus_gelada        KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Trachypithecus_francoisi    KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
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Mus_musculus                  SSKGYNLFIV AAHELGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQFLYGPG DEDPNPKHPK
Aotus_nancymaae               SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQFLYGPG DEDPNPKHPK
Carlito_syrichta              SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK NHFVLPDDDV QGIQTLYGPG DEDPNPKHPK
Cebus_imitator                SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTSK SHFMLPDDDV QGIQFLYGPG DEDPNPKHPK
Gorilla_gorilla               SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Lemur_catta                   SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFVLPDDDV QGIQSLYGPG DEDPNPKHPK
Macaca_mulatta                SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Macaca_nemestrina             SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Microcebus_murinus            SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFVLPDDDV QGIQSLYGPG DEDPNPKHPK
Nomascus_leucogenys           SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Nycticebus_coucang            SSKGYNLFLV AAHELGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPEDDV QGIQFLYGPG DEDPNPKHPK
Otolemur_garnettii            SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFVLPEDDV QGIQSLYGPG DEDPNPKHPK
Pan_paniscus                  SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Pan_troglodytes               SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Papio_anubis                  SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFVLPDDDV QGIQSLYGPG DEDPNPKHPK
Piliocolobus_tephrosceles     SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Pongo_abelii                  SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Pongo_pygmaeus                SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Saimiri_boliviensis           SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTSK NHFMLPDDDV QGIQFLYGPG DEDPNPKHPK
Sapajus_apella                SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTSK SHFMLPDDDV QGIQFLYGPG DEDPNPKHPK
Symphalangus_syndactylus      SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Theropithecus_gelada          SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFVLPDDDV QGIQSLYGPG DEDPNPKHPK
Trachypithecus_francoisi      SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
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                             281
Homo_sapiens                 TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Mus_musculus                 TPEKCDPALS LDAITSLRGE TMIFKDRFFW RLHPQQVEAE LFLTKSFWPE LPNHVDAAYE HPSRDLMFIF
Aotus_nancymaae              TPDKCDPSLS LDAITSLRGE TMVFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSRDLIFIF
Carlito_syrichta             TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSRDLIFIF
Cebus_imitator               TPDKCDPSLS LDAITSLRGE TMVFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Gorilla_gorilla              TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSYDLIFVF
Lemur_catta                  TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPAHDLVFVF
Macaca_mulatta               TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Macaca_nemestrina            TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Microcebus_murinus           TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLVFFF
Nomascus_leucogenys          TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Nycticebus_coucang           TPDKCDPSLS LDAITSLRGE TIIFKDRFFW RLHPQQVDAE LFLTKSFWME LPNRIDAAYE HPSHDLVFIF
Otolemur_garnettii           TPDKCDPSLS LDAITNLRGE TIIFKDRFFW RLHPQQVDAE LFLTKSFWLE LPNRIDAAYE HPSHDLVFIF
Pan_paniscus                 TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Pan_troglodytes              TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Papio_anubis                 TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Piliocolobus_tephrosceles    TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Pongo_abelii                 TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Pongo_pygmaeus               TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Saimiri_boliviensis          TPDKCDPSLS LDAITSLRGE TMVFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Sapajus_apella               TPDKCDPSLS LDAITSLRGE TMVFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Symphalangus_syndactylus     TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Theropithecus_gelada         TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Trachypithecus_francoisi     TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
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Aotus_nancymaae              RGRKFWALNG YDILEGYPKK ISELGFPKEI KKISAAVHFE DTGRTLFFSG NHVWRYDDTN QIMDKDYPRL
Carlito_syrichta             RGRKFWALNG YDIMEGYPQK ISELGFPKEV KKISAAVHFE DTGKTLFFSG NQVWSYDDTN HVMDKDYPRF
Cebus_imitator               RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGRTLFFSG NQVWRYDDTN QIMDKDYPRL
Gorilla_gorilla              RGRKFWALNG YDILEGYPKK ISELGLPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Lemur_catta                  RGRKFWALNG YDIMEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLFFSG NQVWRYDDTN HIMDTDYPRL
Macaca_mulatta               RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Macaca_nemestrina            RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Microcebus_murinus           RGRKFWALNG YDIMEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLFFSG NQVWRYDDTN QIMDKDYPRL
Nomascus_leucogenys          RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Nycticebus_coucang           RGRKFWALNG YDIMEGYPKK ISELGFPKEV KKISAAVHFE DRGKTLFFSG NQVWSYDDTN HIMDKDYPRL
Otolemur_garnettii           RGRKFWALNG YDIMEGYPKK ISELGFPKEV KKISAAVHFE DRGKTLFFSG NQVWSYDDTN HIMDKDYPRL
Pan_paniscus                 RGRKFWALNG YDILEGYPKK ISELGLPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Pan_troglodytes              RGRKFWALNG YDILEGYPKK ISELGLPKEV KKISATVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Papio_anubis                 RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Piliocolobus_tephrosceles    RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Pongo_abelii                 RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Pongo_pygmaeus               RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Saimiri_boliviensis          RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLFFSG NQVWRYDDTN QIMDKDYPRL
Sapajus_apella               RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGRTLFFSG NQVWRYDDTN QIMDKDYPRL
Symphalangus_syndactylus     RGRKFWALNG YDILEGYPQK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Theropithecus_gelada         RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Trachypithecus_francoisi     RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
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                              421
Homo_sapiens                  IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Mus_musculus                  IEEEFPGIGN KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPTNSIL
Aotus_nancymaae               IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSKRI VRVMPANSIL
Carlito_syrichta              IEEVFPGIGD KVDAVYEKNG YIYFFNGPIQ FEF------- ---------- ---SVWSKRI VRVMTANSLL
Cebus_imitator                IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSKRI VRVMPANSIL
Gorilla_gorilla               IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Lemur_catta                   IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPTNSLL
Macaca_mulatta                IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Macaca_nemestrina             IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Microcebus_murinus            IEEDFPGIGD KVDAVYEKNG YIYFFSGPIQ FEY------- ---------- ---SIWSNRI VRVMPTNSLL
Nomascus_leucogenys           IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Nycticebus_coucang            IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSDRI VRVMPTNALL
Otolemur_garnettii            IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPTNALL
Pan_paniscus                  IEEEFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Pan_troglodytes               IEEEFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Papio_anubis                  IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Piliocolobus_tephrosceles     IEEDFPGIGD KVDAVYEKNG YIYFFNGPTQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Pongo_abelii                  IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Pongo_pygmaeus                IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Saimiri_boliviensis           IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSKRI VRVMPANSIL
Sapajus_apella                IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSKRI VRVMPANSIL
Symphalangus_syndactylus      IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Theropithecus_gelada          IEEDFPGIGD KVDAVYEKNE SHFVVQAGVQ WHNLSSLQPP PPGFKRFSCL SLRSSWNYRL YLFFQRAHTV
Trachypithecus_francoisi      IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
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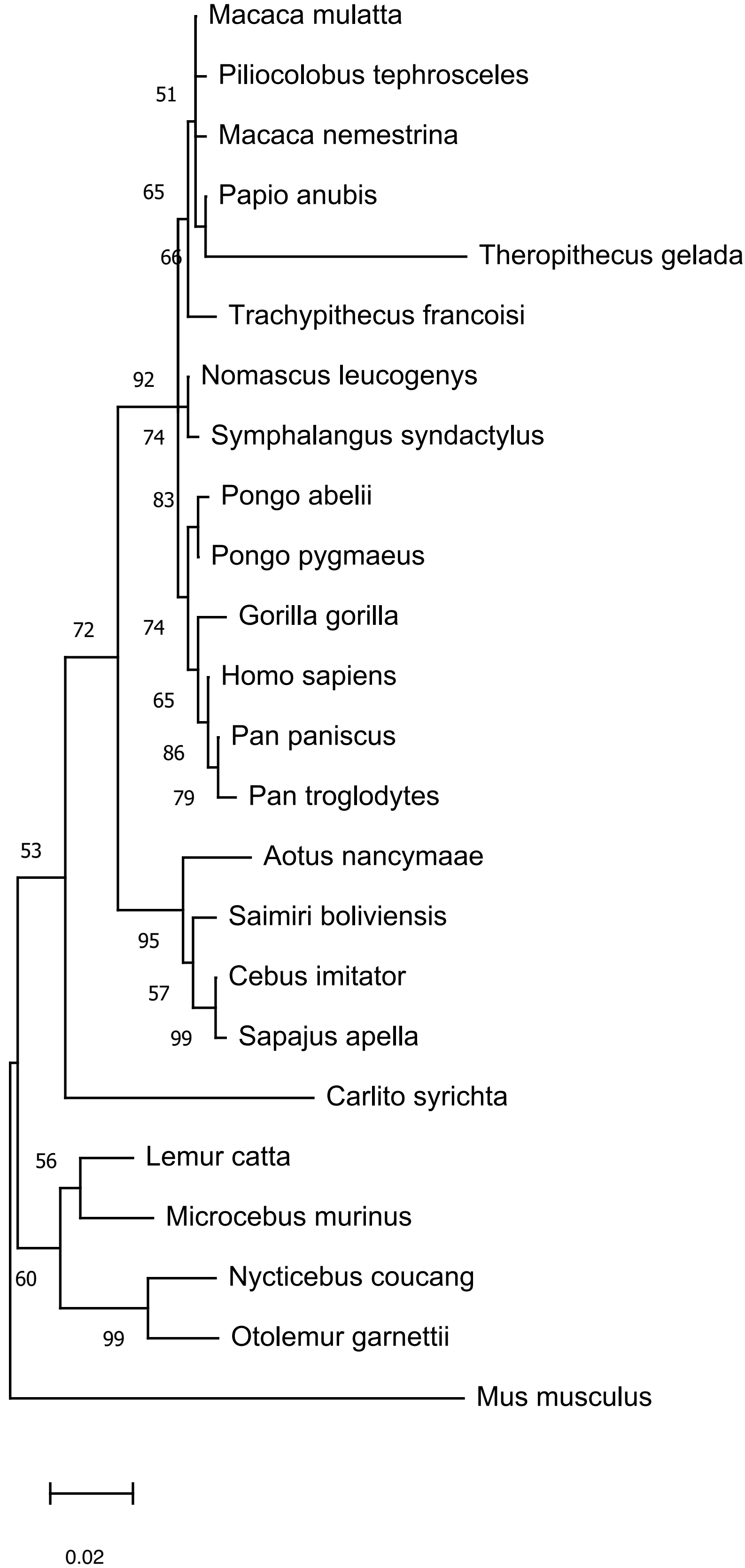
| | 491 |
|---|---|
| Homo_sapiens | WC |
| Mus_musculus | WC |
| Aotus_nancymaae | WC |
| Carlito_syrichta | WC |
| Cebus_imitator | WC |
| Gorilla_gorilla | WC |
| Lemur_catta | WC |
| Macaca_mulatta | WC |
| Macaca_nemestrina | LC |
| Microcebus_murinus | WC |
| Nomascus_leucogenys | WC |
| Nycticebus_coucang | WC |
| Otolemur_garnettii | WC |
| Pan_paniscus | WC |
| Pan_troglodytes | WC |
| Papio_anubis | WC |
| Piliocolobus_tephrosceles | WC |
| Pongo_abelii | WC |
| Pongo_pygmaeus | WC |
| Saimiri_boliviensis | WC |
| Sapajus_apella | WC |
| Symphalangus_syndactylus | WC |
| Theropithecus_gelada | -- |
| Trachypithecus_francoisi | WC |


Macaca mulatta
Piliocolobus tephrosceles
Macaca nemestrina
Papio anubis
Theropithecus gelada
Trachypithecus francoisi
Nomascus leucogenys
Symphalangus syndactylus
Pongo abelii
Pongo pygmaeus
Gorilla gorilla
Homo sapiens
Pan paniscus
Pan troglodytes
Aotus nancymaae
Saimiri boliviensis
Cebus imitator
Sapajus apella
Carlito syrichta
Lemur catta
Microcebus murinus
Nycticebus coucang
Otolemur garnettii
Mus musculus
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65
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**LIST OF REFERENCES**


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A glimpse on the discussions…

# A Bioinformatic Study on the Molecular Evolution of Collagenases in Primates

*A project report submitted to the **University of Calicut** in partial fulfilment of the requirement for the award of the Degree*

## BACHELOR OF SCIENCE IN ZOOLOGY

BY


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## CERTIFICATE

This is to certify that the project work entitled **'A Bioinformatic Study on the Molecular Evolution of Collagenases in Primates'** is an authentic record of research work carried out by **Chandana Janardhanan, Lakshmi AP, Niharika, Salvador VS, Abhinav Krishna PV, Aysha Nedha Sakir, Mithralmajan PT, Anjima NC** and **Grace Maria Paulson** as part of BSc syllabus during the year **2023-2024** and the results of this work has not been presented for the award of any other degree/ diploma in any university.

### Certified bona fide by

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# DECLARATION

We, the following students do hereby declare that this project report entitled **'A Bioinformatic Study on the Molecular Evolution of Collagenases in Primates'** is a genuine record of the project work done by us under the guidance of Dr. Leyon Varghese, Assistant Professor, Department of Zoology, Christ College (Autonomous), Irinjalakuda and that this report has not been submitted to any University/Institution for the award of any Degree or Diploma. We further declare that the results presented in this work and considerations made therein, contribute in general to the advancement of knowledge in science and is devoid of any plagiarism.

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Date : 28-02-2024

# CONTENTS

## INTRODUCTION

The first true primates evolved around 55 million years ago or a bit earlier, near the beginning of the Eocene Epoch. Their fossils have been found in North America, Europe, and Asia. They looked different from the present day primates. Changes in gene regulation and differences in mRNA expression levels across primates have often been documented, however, it is not yet known to what extent measurements of divergence in mRNA levels reflect divergence in protein expression levels, which are probably more important in determining phenotypic differences. Collagenases, a subgroup of Matrix matalloproteases (MMPs) are a large family of zinc-dependent endopeptidases with a great affinity for several components of the extracellular matrix. The collagenases include MMP-1 (interstitial collagenase/collagenase-1), MMP-8 (neutrophil collagenase/collagenase-2), and MMP-13 (collagenase-3). These MMPs attack triple helical regions of interstitial collagen types I, II, and III at a specific single site after the Gly residue of the partial sequences Gly-(Ile or Leu)-(Ala or Leu), located about three-fourths of the distance from the N-terminus. This cleavage generates fragments approximately three-fourths and one-fourth of the size of the collagen molecules. They are distinct from a closely related gelatinases (MMP2 and 9) that are characterized by the presence of the additional fibronectin domain located inside the catalytic domain.

A phylogenetic tree or evolutionary tree is a graphical representation which shows the evolutionary history between a set of species or taxa during a specific time. In other words, it is a branching diagram or a tree showing the evolutionary relationships among various biological species or other entities based upon similarities and differences in their physical or genetic characteristics. In evolutionary biology, all life on Earth is theoretically part of a single phylogenetic tree, indicating common ancestry. Phylogenetics is indeed the study of this phylogenetic tree. The main challenge is to find a phylogenetic tree representing optimal evolutionary ancestry between a set of species or taxa. The first step in the phylogenetic tree construction (using bioinformatics tool) with a new sequence would be to use BLAST. This nifty yet powerful resource matches your sequence to the millions of sequences stored in genomic and nucleotide databases. The tool comes up with the sequences most similar to the query submitted.

It also gives insights as to the possible identity of those sequences. The results include homologues across species and in similar tissues or organisms. A sequence alignment is a way of arranging the sequences of DNA, RNA, or protein to identify regions of similarity that may be a consequence of functional, structural, or evolutionary relationships between the sequences. If two sequences in an alignment, they share a common ancestor and mismatches can be interpreted as point mutations and gaps as indels (that is, insertion or deletion mutations) introduced in one or both lineages in the time since they diverged from one another. In sequence alignments of proteins, the degree of similarity between amino acids occupying a particular position in the sequence can be interpreted as a rough measure of how conserved a particular region or sequence motif is among lineages.

Phylogenetics and sequence alignment are closely related fields due to the shared necessity of evaluating sequence relatedness. The field of phylogenetics makes extensive use of sequence alignments in the construction and interpretation of phylogenetic trees, which are used to classify the evolutionary relationships between homologous genes represented in the genomes of divergent species. The degree to which sequences in a query set differ is qualitatively related to the sequences evolutionary distance from one another. Roughly,  high sequence identity suggests that the sequences in question have a comparatively young most recent common ancestor, while low identity suggests that the divergence is more ancient. This approximation, which reflects the "molecular clock" hypothesis that a roughly constant rate of evolutionary change can be used to extrapolate the elapsed time since two genes first diverged , assumes that the effects of mutation and selection are constant across sequence lineages.

## REVIEW OF LITERATURE

Primates are unique among placental mammals. Two extreme type of placentation are present in this single order. Strepsirrhines have non-invasive epitheliochorial placentation and Haplorhines have highly invasive haemochorial placentation. Strepsirrhines include Lemurs and Lorisiforms and Haplorhines include tarsiers and higher primates. Resemblance in placenta type provide the first evidence that tarsiers are linked to higher primates and distinct from lemurs and lorisiforms. Tree-shrews have endotheliochorial placentation and differ from both primate subgroups. Endotheliochorial placentation is primitive and epitheliochorial placentation is unlikely to be primitive.The recent availability of comprehensive molecular phylogenies for placental mammals has provided an independent framework to determine the most parsimonious interpretation of the evolution of placenta types (Robert Martin, 2008). In an earlier elaborate study, speciation between primates and rodents was estimated by looking at the protein coding genes of mitochondrial genomes from 31 mammals (A.D Yoder 2000). Based on paleontological data, three calibration points were used: one at 20–25 MYA for the hominoid/cercopithecoid divergence, one at 53–57 MYA for the cetacean/artiodactyl divergence, and the third at 110–130 MYA for the metatherian/eutherian divergence. Nulceotide and the amino acid sequence were looked at and results produced that were not mutually exclusive.

Even with decades of data and methods, we still can’t agree on the exact evolutionary tree of higher primates (apes and humans). The most likely scenario has humans closest to chimps, but other possibilities exist. Despite numerous theories, 20 key reasons cause this uncertainty. New methods using DNA offer hope for more definitive answers. (Holmquist et al 1988). Primate phylogeny forms a solid framework for a novel depiction of diverse patterns of genome evolution among primate lineages. They are essential for future comparative genomic investigation of adaptation and selection in humans and across primates. Studies on the evolution of catarrhine primates were done using molecular, fossil and bio geographical data. It was found that the common ancestor of Old World Monkeys originated in Africa and some monkeys later moved to Asia around 10 million years ago. The study further suggested that the ancestor of the

living hominids left Africa about 20 mya and the common ancestor of the living African apes returned to Africa from Eurasia around 10 mya (Caro-Beth Stewart, Todd R Disotell 1998).

In the deep study of evolutionary roots of strepsirrhine primate labyrinthine morphology, geometric morphometric analysis showed that the labyrinthine morphology of extant strepsirrhines contains a mixed locomotor, allometric and phylogenetic signal. Discriminant analysis at the family level confirmed that labyrinthine shape is a good taxonomic marker. The results support the hypothesis that evolutionary change in labyrinthine morphology is adequately described with a random walk model, i.e. random phenotypic dispersal in morphospace (Lebrun et al, 2010). An overview of the taxonomy of New World primates based on morphology to the great number of studies based on molecular data aiming for the elucidation of the phylogeny of New World monkeys. The traditional classification of the infraorder Platyrrhini divided these primates into Cebidae and the Callitrichidae, with Callimico being allocated to either the former (Simons, 1972, Simpson, 1945) or the latter family. Hill (1957) and Hershkovitz, 1972, Hershkovitz, 1977 proposed a third family – Callimiconidae – to accommodate Callimico, because it shares characteristics that define both cebids and callitrichids. According to Hershkovitz (1977), then all New World primates should be included in one of three families – the Callitrichidae which comprised the marmosets, tamarins (Saguinus) and lion tamarins (Leontopithecus), the monotypic Callimiconidae (Callimico) and the Cebidae (Schneider et al, 2015).

In a study on molecular phylogeny and evolution of primate mitochondrial DNA, researchers determined nucleotide sequences of homologous 0.9-kb fragments of mitochondrial DNAs (mtDNAs) derived from four species of old-world monkeys, one species of new-world monkeys, and two species of prosimians. With these nucleotide sequences and homologous sequences for five species of hominoids, they constructed a phylogenetic tree for the four groups of primates. The phylogeny obtained is generally consistent with evolutionary trees constructed in previous studies. The results also suggest that the rate of nucleotide substitution for mtDNAs in hominines (human, chimpanzee, and gorilla) have slowed down compared with that for old-world monkeys (Hayasaka, 1988). Mitochondrial genomes have been used to study the

phylogenetic relationship of primates in detail. Using 454 sequencing, the study adds 32 new complete mitochondrial genomes and introduces 20 previously unrepresented genera in the primate tree. The study focuses on the New world monkeys and suborder Strepsirrhini. (Knut Finstermeier, et al 2013). The evolutionary relationships of the number of species within the genus Lepilemur were analysed with the help of a comparative cytogenetic and molecular study. The study involved the complete sequencing of the mitochondrial cytochrome b gene from 68 individuals and the results were compared to those obtained from cytogenetic studies derived from 99 specimens. The results support the classification of the eight major supportive lemur taxa as independent species. (Nicole Andriaholinirina, et al. 2006)

The relationship between the prion protiens and new world primate phylogeny have been studied. The PrP C prion protein contains 250 amino acids with some variation among species and is expressed in several cell types. Variations in the prion protein gene were observed among 16 genera of New World primates (Platyrrhini), and resulted in amino acid substitutions when compared with the human sequence. Schneider et al, 2004)

Beta-globin gene cluster of primates were analyzed to understand their evolutionary history. The rate of accumulation of mutations have also been seen to vary by a factor of 7 among different primate lineages. The study groups superfamilies Lemuroidea and Lorisoidea into suborder Strepsirhini and Tarsius and Anthropoidea into suborder Haplorhini. Evolution rates have been suggested to have slowed down over the past 25 million years of hominoid descent and has found to have happened in correlation with lengthened lifespans (Koop, BF et al 1989).

Using the SINE's methods for the analysis of mobile element based of old world monkeys. It helps to known ancestral staples. Makes them to useful genetic studies for phylogenetic studies. Alu is an helping part of it, in this methods found 285 new Alu Insertions from sixteen old world monkeys. Old world monkeys are represent on the most diverse and largest primate families. And have respect classification. The phylogenetic researchers are classified and grouped the old world monkeys into different classes and divisions. Mainly the subfamily cerocopithecidae are the most studied group.. SINEs ( short interspersed element are

used as the genetic markers this will helps to analysis several levels of phylogenetic analysis. Using both Compcompuational and PCR methods (Xing a et al, 2005).

New world monkeys represent monophyletic group. The phylogenetic relationships among new world monkeys have been extensively investigated using nucleotide sequence from different genome.In these studies still there are some unresolved issues.There are three monophyletic new world monkey families Atelidae, Cebidae and Pitheciidae. As a result Maximum parsimony analysis support the three proposed platyrrhine families. In the maximum parsimony tree, the two most closely related families are Atelidae and Cebidae.Phylogenetic relationships were reconstructed by maximum parsimony, maximum likelihood, and Bayesian approaches (JuanC Opazo et al, 2006). Anthropoid primates from the neotropics are members of parvorder Platyrrhini. The platyrrhines are also called New World monkeys. There are more than 125 species of extant New World monkeys found in approximately 15 genera. The phylogenetic relationships of these neotropical primates have been extensively studied from a molecular perspective (Derek wildman et al, 2009).

Phylogenetic trees are certainly useful for comparative studies, providing a useful framework for comparative biologists. Species evolution is not statistically independent. The fact that close relatives inherit characteristics from their common ancestor has always complicated the analysis of cross- species data. The methods in turn developed to resolve such issues, all requires resolved phylogeny. In one of the earlier studies, primates phylogeny was estimated of all 203 species of primates. Application of parsimony algorithm and bootstrapping resulted in the composite tree with 160 nodes (Purvis, Andy 1995).

In a project conducted under the support from National Cancer Institute and National Institute of Health, researchers constructed a robust phylogenetic tree of primates. The tree was constructed from the data collected of genomic sequences from 186 primates. Also outgroup species from Dermoptera, Scandentia and Lagomorpha was included. This phylogenetic representation done carefully was a notable illumination showing the pathway of primates evolution (Perelman et.al 2011).

Studies also estimated the molecular divergence dates of major primates in the context of molecular clock studies. Such studies also aid in understanding the lineage. Utilizing the genomic data, molecular divergence dates were able to be studied since alignments can be arranged and sites can be analysed for this study. Much before the molecular clock, paleontology used to provide only a mere timeframe of species evolution (Steiper et.al. 2006).

Inferring molecular phylogeny for evolutionary studies are done in non- primates as well. The molecular phylogeny of malarial parasites was recovered from mitochondrial cytochrome b gene sequences. Parsimony as well as maximum- likelihood analysis produced similar phylogenetic trees in this case. The conclusions were supported by hypothesis testing (Perkins et.al 2002). Inferring species super matrix has helped in studying macroevolutionary dynamics and even historical biogeography. The results obtained highlighted both the power as well as limitations of inferring the molecular phylogeny data to different species concepts (Springer et.al. 2012).

Over the past 60 million years, a million copies of Alu DNA have appeared in the genomes of primates. This is still an ongoing process. DNA alu repeats in the genomes of primates such as human, chimpanzee, gorilla, orangutan, baboon, rhesus, and macaque. New Alu elements arise in unique and irreversible events and appear to prevent precise excision and loss. The same insertions cannot occur independently in two species. Once the insert is genetically fixed, the DNA elements persist in all descendant lineages. Different from point mutation, the distribution of individual alu corresponds to a phylogeny only (H. Hamdi, 1999).

To resolve the debate in strepsirrhine phylogeny, 61 loci containing interspersed elements were characterized and the absence and presence of orthologous loci in the strepsirrhine panel was determined. According to these findings, it is concluded that strepsirrhines originated in Africa, and that Madagascar and Asia were colonized by immigration events (C. Roos, 2004). To investigate the phylogenetic relationships among species of New World monkeys, 1.3 kb of DNA was collected for 2 introns of the glucose-6-phosphate dehydrogenase locus encoded on the x chromosome of 24 species of New World monkeys (M. Von. Dornum, 1999).

Two molecular based approaches are used to date the initial divergence of the platyrrhine clade, a relaxed clock model using fossil record and genome datasets, and Bayesian inferences from generation time and body size to substitution rate. Fossil constraints, topology, and substitution rate are an important part of our divergence time estimates. making an impact. Bayesian estimates using conservative and realistic fossil constraints suggest that the LCA of extant platyrrhines is 29 Ma, with a 95% confidence interval for Nodine of 27–31 Ma (SI Perez, 2013). The sequences of nuclear protein-coding gene LCAT were used to study the relationship between 19 extant rodents. The study agrees with several previous molecular and morphological studies, both concerning branching orders inside Muroidea and the bush-like radiation of rodent suprafamilial taxa. This indicates that this nuclear gene is a fitting candidate for tackling questions about rodents relationships.

The data from primates were used to reveal that the molecular clock in CpG and non-CpG sites have different nature, projecting differences in their molecular origin. Through the process, it was observed that molecular clocks are heterogeneous even within a genome. During phylogenetic analysis and while concluding divergence times using molecular data, one should be mindful that different regions of genome follow different molecular clocks. In this study, our efforts are directed towards studying the pathway of certain collagenases in the course of evolution. Even though some studies have been done using DNA sequences and that too in different context, in our study we focusses primarily on amino acid sequences. This is not a well researched area. Though this study we aim on providing a new work in the area of comparative biology. The results of the work may be useful in the future providing insights into how may be the few crucial changes in amino acids may have resulted into a complete new lineage.

## SIGNIFICANCE OF THE STUDY

The study of molecular evolution in primates through the comparison of amino acid sequences using bioinformatics tools represents a novel and underexplored area of research. To date, there has been a notable scarcity of studies employing bioinformatics techniques to investigate the evolutionary patterns of primates, particularly in relation to proteins such as MMP1, MMP8 and MMP13 collagenases. The selection of these collagenases for our study is particularly significant due to their split genes nature. By conducting a comparative analysis of the evolutionary trees derived from the collagenases with established standard trees, we aimed to shed light on the distinctive evolutionary trajectories of these proteins in primates. The insights obtained from this comparative study have the potential to deepen our understanding of the molecular evolution of primates and elucidate the factors driving the evolution of collagenases in this taxonomic group.

**OBJECTIVES**

1. Retrieval of relevant data (Gene/mRNA/protein sequence of collagenases of primates) from relevant reliable resources such as NIH or SIB.
2. Align the retrieved sequences using bioinformatics software to ensure they are in the correct reading frame and homologous positions are appropriately aligned.
3. Construction of the phylogenetic trees based on the Gene/mRNA/protein sequence of collagenases in primates.

## METHODOLOGY

The three human collagenases used in the study are MMP1, MMP8 and MMP13. The FASTA sequence and other details of collagenases are as below.

```
>NP_002412.1 interstitial collagenase isoform 1 MMP1 UniProt_P03956 [Homo sapiens]
MHSFPPLLLLLFWGVVSHSFPATLETQEQDVDLVQKYLEKYYNLKNDGRQVEKRRNSGPVVEKLKQMQEF
FGLKVTGKPDAETLKVMKQPRCGVPDVAQFVLTEGNPRWEQTHLTYRIENYTPDLPRADVDHAIEKAFQL
WSNVTPLTFTKVSEGQADIMISFVRGDHRDNSPFDGPGGNLAHAFQPGPGIGGDAHFDEDERWTNNFREY
NLHRVAAHELGHSLGLSHSTDIGALMYPSYTFSGDVQLAQDDIDGIQAIYGRSQNPVQPIGPQTPKACDS
KLTFDAITTIRGEVMFFKDRFYMRTNPFYPEVELNFISVFWPQLPNGLEAAYEFADRDEVRFFKGNKYWA
VQGQNVLHGYPKDIYSSFGFPRTVKHIDAALSEENTGKTYFFVANKYWRYDEYKRSMDPGYPKMIAHDFP
GIGHKVDAVFMKDGFFYFFHGTRQYKFDPKTKRILTLQKANSWFNCRKN

>NP_002415.1 neutrophil collagenase isoform 1 MMP8 UniProt_P22894 [Homo sapiens]
MFSLKTLPFLLLLHVQISKAFPVSSKEKNTKTVQDYLEKFYQLPSNQYQSTRKNGTNVIVEKLKEMQRFF
GLNVTGKPNEETLDMMKKPRCGVPDSGGFMLTPGNPKWERTNLTYRIRNYTPQLSEAEVERAIKDAFELW
SVASPLIFTRISQGEADINIAFYQRDHGDNSPFDGPNGILAHAFQPGQGIGGDAHFDAEETWTNTSANYN
LFLVAAHEFGHSLGLAHSSDPGALMYPNYAFRETSNYSLPQDDIDGIQAIYGLSSNPIQPTGPSTPKPCD
PSLTFDAITTLRGEILFFKDRYFWRRHPQLQRVEMNFISLFWPSLPTGIQAAYEDFDRDLIFLFKGNQYW
ALSGYDILQGYPKDISNYGFPSSVQAIDAAVFYRSKTYFFVNDQFWRYDNQRQFMEPGYPKSISGAFPGI
ESKVDAVFQQEHFFHVFSGPRYYAFDLIAQRVTRVARGNKWLNCRYG

>NP_002418.1 collagenase 3 MMP13 UniProt_P45452 [Homo sapiens]
MHPGVLAAFLFLSWTHCRALPLPSGGDEDDLSEEDLQFAERYLRSYYHPTNLAGILKENAASSMTERLRE
MQSFFGLEVTGKLDDNTLDVMKKPRCGVPDVGEYNVFPRTLKWSKMNLTYRIVNYTPDMTHSEVEKAFKK
AFKVWSDVTPLNFTRLHDGIADIMISFGIKEHGDFYPFDGPSGLLAHAFPPGPNYGGDAHFDDDETWTSS
SKGYNLFLVAAHEFGHSLGLDHSKDPGALMFPIYTYTGKSHFMLPDDDVQGIQSLYGPGDEDPNPKHPKT
PDKCDPSLSLDAITSLRGETMIFKDRFFWRLHPQQVDAELFLTKSFWPELPNRIDAAYEHPSHDLIFIFR
GRKFWALNGYDILEGYPKKISELGLPKEVKKISAAVHFEDTGKTLLFSGNQVWRYDDTNHIMDKDYPRLI
EEDFPGIGDKVDAVYEKNGYIYFFNGPIQFEYSIWSNRIVRVMPANSILWC
```

The study on phylogenetic relationships in primates was conducted using this amino acid sequences to do the BLAST (Basic Local Alignment Search Tool) analysis in the NCBI Genebank database. The most suitable amino acid sequences for each primate species were then carefully selected from sequences delivered by the server. An out group was chosen which in our study was the Mus musculus of the order Rodentia.

The selected sequences were then compared with that of the out group and a phylogenetic tree was constructed based on the degree of divergence. The software used for constructing phylogenetic tree was  Molecular Evolutionary Genetics Analysis (MEGA).

## RESULTS AND DISCUSSIONS

The research article titled “A Molecular Phylogeny of Living Primates” published in 2011, established a robust and widely accepted framework for understanding primate evolution. This phylogenetic tree served as a standard reference for our study, allowing us to compare our data and draw conclusions. According to this article Order Primata is subdivided into two major Suborder Haplorrhini and Strepsirrhini. The remaining primate phylogeny is classified as follows.

**Suborder Haplorrhini** further divides into Infraorders, namely Simiiformes and Tarsiiformes. Tarsiiforme include only one Family (Tarsiidae) with only two extant species. Simiiformes is subdivided into Parvorders Catarrhini (Old world) and Platyrrhini (New world).

Parvorder Catarrhini in turn consist of the Superfamilies Cercopithecoidea and Hominoidea. Cercopithecoidea has only one extant Family *viz*. Cercopithecidae but the organisms of Superfamily Hominoidea is further divided into two Families, *viz*, Hylobatidae and Hominidae. Family Cercopithecidae has two Subfamilies such as Cercopithecinae and Colobinae. Family Hylobatidae include all Gibbon Genus and there is no further subgrouping. Hominidae on the other hand has two Subfamilies *viz.* Homininae and Ponginae. Subfamily Ponginae include all species of Orangutang and all o there Greater Apes and Humans are included in Homininae. Subfamily Cercopithecinae is subdivided into two Tribes namely, Papionini and Cercopithecini whereas Colobinae is subdivided into two Tribes namely Presbytini and Colobini.

Parvorders Platyrrhini on the other hand is divided directly into three Families such as Cebidae, Atelidae and Pitheciidae. Family Cebidae has four Subfamilies namely, Callitrichinae, Aotinae, Cebinae and Saimirinae. Fly. Atelidae has two Subfamilies (Atelinae & Alouattinae) so also Fly. Pitheciidae (Callicebinae & Pitheciinae).

**Suborder Strepsirrhini** is divided into the Infraorders Lemuriformes, Chiromyiformes and Lorisiformes. Unlike Haplorrhini, there is no observed grouping of these Infraorders into Parvorders or Superfamilies. Instead, they are grouped into Families such as Lepilemuride,

Cheirogaleidae, Indriidae, Lemuridae, Daubentoniidae, Lorisidae and Galagidae. Further subdivision within Lorisidae includes the subfamilies Lorisinae and Perodicticinae.

**<u>MMP-</u>1**

The phylogenetic tree for the MMP1 gene in primates was meticulously constructed, employing an analysis of amino acid sequences from various primate species. To enhance our phylogenetic analysis, *Mus musculus* was strategically employed as the outgroup, providing a reference point for the evolutionary relationships within the MMP1 collagenase gene among primates. Our investigation also utilized a well established standard phylogenetic tree for primates, derived from genomic sequences across diverse species, serving as a foundational reference for elucidating the evolutionary dynamics of collagenase genes within our study group (Reference). The results obtained regarding the evolutionary pathway of the MMP1 gene include the following observations:

- *Carlito syrichta*: Our findings indicate that MMP1 gene of *Carlito syrichta,* a tarsier species primarily descended with minimal changes from the common ancestor of all primates indicating an ancient ancestry. Although this tree suggests such an ancient ancestry and early divergence of *Carlito syrichta* from the early primate stock, a comparison with the established tree reveals that tarsiers diverged from a common stock of strepsirrhini - more primitive primate. It is therefore inferred that the MMP1 gene remained with minimum changes in the tarsiers as compared to strepsirrhini primates.

- *Hominidae:* In our tree constructed using MMP1 the common ancestor of *Pan* and *Homo*, along with the common ancestor of *Gorilla* and *Pongo,* collectively share a common ancestor. Gibbons, including *Nomascus* and *Symphalangus,* share a common ancestor that along with the common ancestor of *Hominidae* were descended from a common stock of interbreeding ape like animal. Upon analysing the standard phylogenetic tree, a similar pattern emerges, with *Homo* and *Pan* sharing a common ancestor. This common ancestor was also ancestral to present day *Gorilla,* from which the *Pongo* ancestry might have diverged. However, the discrepancy in our results suggestive of *Gorilla* sharing a recent

common ancestor with *Pongo,* but not with *Homo* or *Pan*. This suggests a simultaneous origin for *Gorilla* and *Pongo*, contrary to the standard tree's assertion of *Gorilla*'s more recent evolution compared to *Pongo*. Further analysis of the amino acid sequences are required to see if the *Homo-Pan* group has any common advantage with the kind of changes on the MMP1 protein over the *Gorilla-Pongo* group.

- Old World Monkeys: Our results indicate that, three groups *viz. Macaca*, *Papio* and *Theropithecus* are equally distant from a common ancestor, while *Colobus* and *Trachypithecus* share another common ancestor. The standard phylogenetic tree confirms this, revealing a common ancestor for *Colobus* and *Trachypithecus,* along with the ancestor of *Macaca, Papio* and *Theropithecus*. But with *Macaca, Papio* and *Theropithecus,* our results differ from the standard tree. While standard tree implies that *Papio* and *Theropithecus* had a common ancestor after the common ancestry shared with *Macaca,* our tree do not mention between an ancestor common to both *Papio* and *Theropithecus*. Though the changes are minimal, it wold be interesting to look for the their sequences for further analysis.

- New World Monkeys: Our findings in New World Monkeys suggest that *Saimiri* and *Cebus* share a most recent common ancestor, while *Aotus* share a common ancestor with this lineage. This is consistent with both our phylogenetic tree and the standards phylogenetic tree. Furthermore, *Nycticebus* and *Otolemur* share a common ancestor, and *Lemur* and *Microcebus* also share a common ancestor. The common ancestors of these pairs collectively had a single common ancestor, aligning with observations on the standard phylogenetic tree.

**MMP-8**

- *Hominidae*: In the phylogenetic tree derived from MMP8 sequence data, it was observed that the common ancestor of Homo and Gorilla shares ancestry with the common ancestor of Pan. This collective ancestry is further linked to the common ancestor of Hominidae, which is shared with Gibbons. In contrast to the standard phylogenetic tree, where Pan and Homo share an ancestor ancestral to present-day Gorilla, our results suggest the potential existence of an alternative evolutionary pathway for these three species. A comprehensive investigation is recommended to explore the implications of this alternative pathway further.

- Loris: Our findings indicate that the Loris shares a common ancestor with Hominidae, Tarsier, Gibbons, New World, and Old World monkeys, all of which originate from the Strepsirrhini primates. Similarly, Lemurs are shown to arise from Haplorrhini primates. Discrepancies with the standard phylogenetic tree, which suggests a more recent common ancestry for Lemurs and Loris, necessitate further analysis to validate the proposed ancestral pattern among the descendants of these two major groups of early primates.

- New World Monkeys: Upon examining the lineage of New World monkeys, it is observed that recent descendants Aotus and Saimiri share a common ancestor, which is further linked to the common ancestor of Cebus and Sapajus. This lineage can be traced back to early Strepsirrhini primates. Although minor differences are noted compared to the standard phylogenetic tree, where an ancestor common to Saimiri and Cebus precedes the common ancestry with Aotus, further analysis is warranted to explore these nuances.

- Old World Monkeys: Our analysis reveals that Papio and Theropithecus share a common ancestor, which is connected to the common ancestor of Macaca. This ancestral lineage can be traced back to an ancestor shared with the common ancestor of Piliocolobus and Trachypithecus. The observed pattern aligns with the standard phylogenetic tree in the lineage of Old World monkeys.

**MMP-13**

- *Hominidae*: When we comparing the phylogenetic tree made by us on the basis of MMP13 and the standard one, the Nomascus leucogenys & Symphalongus syndactylus (Hylobatidae) share a recent common ancestor and they together share common ancestor with old world monkeys in MMP13. But, when we comparing this with the standard one we can observe that the Hylobatidae sharing common ancestor with Hominidae.

- New World Monkeys: Our findings in new world monkeys by comparing the Standard phylogenetic tree with the phylogenetic tree of MMP13 depicting that, in the phylogenetic tree of MMP13, the Cebus imitator & Sapajus apella shares a recent common ancestor and these group share a common ancestor with Samiri bolivensis and all of these collectively share a common ancestor with Aotus nancymaae. When we comparing this with the standard phylogenetic tree Cebus imitator & Samiri bolivensis directly arrived from a common ancestor.

- Old World Monkeys: By analysing the group Cercopithecidae in the tree of MMP13, Papio Anubis & Theropithecis gelada share a recent common ancestor and they together share a common ancestor with Macaca group, Piliocolobus tephrosceles & Trachypithecus francoisi directly. But when we comparing this with the standard phylogenetic tree, they where not sharing a common ancestor directly, all of them share a common ancestor with other species recently, but all of them primitively share a common ancestor.

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Alignment: D:\Leyon\Evolution\MMP1\1-tree_for_seaview.txt
Seaview [blocks=10 fontsize=12 A4-landscape] on Wed Jan 31 07:26:41 2024

                              1
Homo_sapiens                  MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Mus_musculus                  MPSLP---LL LLLWAASSYS FPVFHNGDRQ NVETVWKYLE NYYNL---GK NMQAKNVNGK EMMAEKLRQM
Aotus_nancymaae               MHSYPP-LLL LLFWGVVSHG FPATLETQEQ DVEIVQKYLE QYYNLKNDGK QVEKKRSSGP --VVEKLKQM
Carlito_syrichta              MPSLP--LVL MLLWAVGSRG FPATSETREQ DVEIVQKYLE NYFNLKNDGK QFEKQRHSAP --VVEKLKEM
Cebus_imitator                MHSYPL-LLL LLFWGVVSHG FPATLETQEQ DVEIVQKYLE QYYNLKNDGK QVEKQRNSGP --VVEKLKQM
Gorilla_gorilla               MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Lemur_catta                   MPSFS--LLL LLLWGLGSHG FPAIPETQEQ DVEIVQKYLE NYYDLKNVGK QIEKKRSSGS --VVEKLKQM
Macaca_mulatta                MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDFVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Macaca_nemestrina             MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Microcebus_murinus            MPRFS--LLL LLLWSLGSHG LPVAPETQEQ DVEIVQKYLE NYYDLKNDGK QIEKKRNSGP --VVEKLKQM
Nomascus_leucogenys           MHSFPPLLLL LLFWSVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGL --VVEKLKQM
Nycticebus_coucang            MPSF---LLL LLLWGLGSHA FPAIPEPQEQ DVEIVQKYLE NYYDLKNDGS QIERKRNSGP --VVEKLKQM
Otolemur_garnettii            MSSFP--LLL LLLWGLGSHA LPVTPETQEQ DVEIVQKYLE NYYDLKNDGM QIERKRNSGP --VVEKLKQM
Pan_paniscus                  MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Pan_troglodytes               MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Papio_anubis                  MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Piliocolobus_tephrosceles     MHSFPPLLLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVQKQRNSGP --VVEKLKQM
Pongo_abelii                  MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Pongo_pygmaeus                MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Saimiri_boliviensis           MHSYPP-LLL LLFWSVVSHG FPATLETQEQ DVEIVQKYLE QYYDLKNDGK QVEKQRNSGP --VVEKLKQM
Sapajus_apella                MHSYPL-LLL LLFWGVVSHG FPATLETQEQ DVEIVQKYLE QYYNLKNDGK QVEKQRNSGP --VVEKLKQM
Symphalangus_syndactylus      MHSFPPLLLL LLFWSVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGL --VVEKLKQM
Theropithecus_gelada          MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Trachypithecus_francoisi      MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDRR QVEKQRNSGP --VVEKLKQM
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                              71
Homo_sapiens                  QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Mus_musculus                  QQLFGLKVTG NSDPETLRAM KKPRCGVPDV APYAITHNNP RWTKTHLTYS ILNYTPYLPK AVVEDAIARA
Aotus_nancymaae               QEFFGLKVTG KPDAETLNVM KQPRCGVPDV ARFVLTEGNP RWEKTHLTYR IENYTPDLPR ADVDQAIEKA
Carlito_syrichta              QKFFGLKVTG KPDPETLKVM KQPRCGVPDV AQFVLTEGNP RWQKTDLTYR IENYTPDLPK AEVDRAIEKA
Cebus_imitator                QEFFGLKVTG KPDAETLKVM KQPRCGVPDV ARFVLTEGNP RWKKTHLTYR IENYTPDLPR SDVDHAIEKA
Gorilla_gorilla               QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Lemur_catta                   QEFFGLKVTG KPDTETLKVM KQPRCGVPDV ARFVLTQGNP RWEQTHLTYR IENYTPDLPR ADVDLAIEKA
Macaca_mulatta                QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR AAVDQAIEKA
Macaca_nemestrina             QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR AAVDQAIEKG
Microcebus_murinus            QEFFGLKVTG KPDTETLKVM KQPRCGVPDV ARFVLTQGNP RWEKTHLTYR IENYTPDLSR ADVDHAIEKA
Nomascus_leucogenys           QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTAGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Nycticebus_coucang            QEFFGLKVTG TPDTETLKVM KQPRCGVPDV ARFALTPGNP RWEQTHLTYR IENYTPDLPR ADVDDAIEKA
Otolemur_garnettii            QEFFGLKVTG TPDTETLKVM KQPRCGVPDV ARFVLTQGNP RWEQTHLTYR IENYTPDLPK ADVDDAIEKA
Pan_paniscus                  QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIAKA
Pan_troglodytes               QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIAKA
Papio_anubis                  QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR AAVDQAIEKA
Piliocolobus_tephrosceles     QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDRAIEKA
Pongo_abelii                  QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Pongo_pygmaeus                QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Saimiri_boliviensis           QEFFGLKVTG KPDAETLNVM KQARCGVPDV ARFVLTEGNP RWEKTHLTYR IENYTPDLRR ADVDHAIEKA
Sapajus_apella                QEFFGLKVTG KPDAETLKVM KQPRCGVPDV ARFVLTEGNP RWEKTHLTYR IENYTPDLPR SDVDHAIEKA
Symphalangus_syndactylus      QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTAGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Theropithecus_gelada          QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR AAVDQAIEKA
Trachypithecus_francoisi      QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDRAIEKA
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141

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|---|---|---|---|---|---|---|---|
| Homo_sapiens | FQLWSNVTPL | TFTKVSEGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDERWTNNF |
| Mus_musculus | FRVWSDVTPL | TFQRVFEEEG | DIVLSFHRGD | HGDNNPFDGP | NYKLAHTFQP | GPGLGGDVHY | DLDETWTNSS |
| Aotus_nancymaae | FQLWSNVTPL | TFTKVPKGQA | DIMISFVRGD | HQDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDETWTNNF |
| Carlito_syrichta | FQLWSNASPL | RFTKVVEGQA | DIMISFVRGD | HQDNSPFYGP | GENLAHAFQP | GPNIGGDAHF | DEDETWTNNI |
| Cebus_imitator | FQLWSNVTPL | TFTKVPKGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GSGIGGDAHF | DEDETWTNNF |
| Gorilla_gorilla | FQLWSNVTPL | TFTKVSEGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDERWTNNF |
| Lemur_catta | FQLWSNASPL | TFTKVFEGQA | DIMISFVRGD | HQDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDEQWTSDS |
| Macaca_mulatta | FQLWSNVTPL | TFTKVSEGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDERWTNNF |
| Macaca_nemestrina | FQLWSNVTPL | TFTKVSEGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDERWTNNF |
| Microcebus_murinus | FQLWSNASPL | TFTRVFEGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDEQWTNNF |
| Nomascus_leucogenys | FKLWSNVTPL | TFTKVSEGQA | DIMISFVRGD | HQDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDERWTNNF |
| Nycticebus_coucang | FRLWSNASPL | TFTKVFQGQA | DIMISFVRGD | HQDNSPFDGP | GGNLAHAFQP | GPGIGGDTHF | DEDERWTNNL |
| Otolemur_garnettii | FQLWSNASPL | TFTKVFQGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDEKWTNNL |
| Pan_paniscus | FQLWSNVTPL | TFTKVSEGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDERWTNNF |
| Pan_troglodytes | FQLWSNVTPL | TFTKVSEGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDERWTNNF |
| Papio_anubis | FQLWSNVTPL | TFTKVSEGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDERWTNNF |
| Piliocolobus_tephrosceles | FQLWSNVTPL | TFTKVSEGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDERWTNNF |
| Pongo_abelii | FQLWSNVTPL | TFTKVSEGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDERWTNNF |
| Pongo_pygmaeus | FQLWSNVTPL | TFTKVSEGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDERWTNNF |
| Saimiri_boliviensis | FQLWSNVTPL | TFTKVPKGQA | DIMISFVRGD | HQDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDETWTNNF |
| Sapajus_apella | FQLWSNVTPL | TFTKVPKGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDETWTNNF |
| Symphalangus_syndactylus | FKLWSDVTPL | TFTKVSEGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DDDERWTNNF |
| Theropithecus_gelada | FQLWSNVTPL | TFTKVSEGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDERWTNNF |
| Trachypithecus_francoisi | FQLWSNVTPL | TFTKVSEGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDERWTNNF |

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Homo_sapiens               REYNLHRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Mus_musculus               ENFNLFYVTA HELGHSLGLT HSSDIGALMF PSYTWYTEDF VLNQDDINRI QDLYGPSPNP IQPTGATTPH
Aotus_nancymaae            REYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGKSQNP VQPTGPQTPQ
Carlito_syrichta           QNYNLYRVAA HEFGHSLGLS HSTDIGALMY PTYT-YSGDV QLAQDDIDGI QAIYGPSQNP IQPTGPQTPQ
Cebus_imitator             RGYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGQSPNP VQPTGPQTPQ
Gorilla_gorilla            REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Lemur_catta                RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYT-FSGDV QLAQDDIDGI QAIYGPSQNP NQPTGPQTPQ
Macaca_mulatta             REYNLYRVAA HEFGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Macaca_nemestrina          REYNLYRVAA HELGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Microcebus_murinus         RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYA-FSGDV QLAQDDIDGI QAIYGPSQNP NQPIGPQTPQ
Nomascus_leucogenys        REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Nycticebus_coucang         RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYA-FSGEV ELAQDDIDGI QAIYGPSQNP IQPIGPQTPQ
Otolemur_garnettii         RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYA-FSGEV ELAQDDIDGI QAIYGPSQNP VQPTGPQTPQ
Pan_paniscus               REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGHSQNP VQPIGPQTPK
Pan_troglodytes            REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Papio_anubis               REYNLYRVAA HELGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Piliocolobus_tephrosceles  REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLSQDDIDGI QAIYGGSQNP VQPTGPQTPK
Pongo_abelii               REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGPSQNP VQPIGPQTPK
Pongo_pygmaeus             REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGPSQNP VQPIGPQTPK
Saimiri_boliviensis        REYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGPSPNP VQPTGPQTPQ
Sapajus_apella             REYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGQSPNP VQPTGPQTPQ
Symphalangus_syndactylus   REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Theropithecus_gelada       REYNLYRVAA HELGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Trachypithecus_francoisi   REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
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                             281
Homo_sapiens                  ACDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Mus_musculus                  PCNGDLTFDA ITTFRGEVFF FKGRFYIRVN RFMPEPELNL IGILWPNLPV KLDAAYEASM IDQVRYFKGS
Aotus_nancymaae               VCDSKLTFDA ITTIRGEVFF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Carlito_syrichta              ACDSKISFDA VTTIRGEVMF FKDRFFMRTH PSYPEADLNF ISDFWPLLPN GLEAAYEDAG RDQVRFFKGY
Cebus_imitator                VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PYYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Gorilla_gorilla               VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLQAAYEFAD RDEVRFFKGN
Lemur_catta                   VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPS GLEAAYEVAS RDEVRFFKGN
Macaca_mulatta                VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Macaca_nemestrina             VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Microcebus_murinus            VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF VSVFWPQLPT GLEAAYEVAD RDEVRFFKGN
Nomascus_leucogenys           VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Nycticebus_coucang            VCDSKLTFDA VTTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPS GLEAAYEVVD RDEIRFFKGN
Otolemur_garnettii            VCDSKLTFDA VTTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEVAD RDEVRFFKGN
Pan_paniscus                  VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PSYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Pan_troglodytes               VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Papio_anubis                  VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Piliocolobus_tephrosceles     VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLQAAYEFAE RDEVRFFKGN
Pongo_abelii                  VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Pongo_pygmaeus                VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Saimiri_boliviensis           VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Sapajus_apella                VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PYYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Symphalangus_syndactylus      VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGK
Theropithecus_gelada          VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Trachypithecus_francoisi      VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLQAAYEFAD RDEVRFFKGN
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                             351
Homo_sapiens                 KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Mus_musculus                 KVWAVQEQSV LRGFPRDIHS FFGFPSNVTH IDAAVCEEET GKTYFFVDHM YWRYDENTQS MDPGYPRLTA
Aotus_nancymaae              KYWAAQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDAGYPKMIA
Carlito_syrichta             RFWAVQGQDV LRGYPQDIYS SYGFPRTVKH IDAAVFEEET GKTFFFVGNK YWRYDEYKRS MDVGYPKMIA
Cebus_imitator               KYWAVQGQNV LYGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDAGYPKKIA
Gorilla_gorilla              KYWAVQGQNM LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDPGYPKMIA
Lemur_catta                  KYWAVQGQNV LPGYPKDIYR SFGFPRTVKH IDAAISEEDT GKTYFFVANK YWRYDEYKQS MDTGYPKKLA
Macaca_mulatta               KYWAVQGQNV LPGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Macaca_nemestrina            KYWAVQGQNV LPGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Microcebus_murinus           KYWAVQGQNV LPGYPKDIYK SFGFPKTVKH IDAAVSEEDT GKTYFFVANK YWRYDEYKQS MDAGYPKMIA
Nomascus_leucogenys          KYWAVQGQNV LHGYPKDIYS SFGFPRTVKR INAALSEENT GKTYFFVAKK YWRYDEYKRS MDPGYPKMIA
Nycticebus_coucang           KYWAVRGQDV LHGYPKDISS SFGFPRTVKH VDAAVSEEET GKTYFFVANK YWRYDENKQS MDTGYPKMIA
Otolemur_garnettii           KYWAVRGPDV LHGYPKDISS SFGFPRTVKH VDAAVSEEET GKTYFFVANK YWRYDENKQS MDTGYPKTIA
Pan_paniscus                 KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Pan_troglodytes              KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Papio_anubis                 KYWAVQGQNV LPGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIS
Piliocolobus_tephrosceles    KYWAVQGQNV LRGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Pongo_abelii                 KYWAVQGQNM LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEHKRS MDPGYPKMIA
Pongo_pygmaeus               KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Saimiri_boliviensis          KYWAVQGQNV LYGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDAGYPKMIA
Sapajus_apella               KYWAVQGQNV LYGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDAGYPKKIA
Symphalangus_syndactylus     KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVAKK YWRYDEYKRS MDPGYPKMIA
Theropithecus_gelada         KYWAVQGQNV LPGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK CWRYDEYKRS MDPGYPKMIA
Trachypithecus_francoisi     KYWAVQGQNV LRGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYERS MDPGYPKMIA
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Homo_sapiens                   HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Mus_musculus                   EDFPGIDDKV DDVFQKGENF YFFHQSVQHR FNLQIRRVDD SRDSSTWFNC ---
Aotus_nancymaae                DDFPGIGHKV DAVFMKDGFF YFFHKTRQYK FEPETKRILT LQKANSWFNC RKN
Carlito_syrichta               HGFPGIGHKV DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKN
Cebus_imitator                 HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Gorilla_gorilla                HDFPGIGHKV DAVFMKDGFF YFFRGRRQYK FDPETKRILT LQKANSWFNC RKN
Lemur_catta                    LDFPGIGHKI DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKK
Macaca_mulatta                 HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Macaca_nemestrina              HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Microcebus_murinus             HDFPGIGHKI DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKN
Nomascus_leucogenys            HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Nycticebus_coucang             HDFPGIGHKV DAVFKKDEFF YFFHGTRQYK FDLKTKRILT LLKANSWFNC RKH
Otolemur_garnettii             HDFPGIGHKV DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKH
Pan_paniscus                   HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Pan_troglodytes                HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Papio_anubis                   HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Piliocolobus_tephrosceles      HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Pongo_abelii                   HDFPGIGHKV DAVFTKDGFF YFFHGTRQYK FDPETKRILT LQKANSWFNC RKN
Pongo_pygmaeus                 HDFPGIGHKV DAVFTKDGFF YFFHGTRQYK FDPETKRILT LQKANSWFNC RKN
Saimiri_boliviensis            HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Sapajus_apella                 HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Symphalangus_syndactylus       HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Theropithecus_gelada           HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Trachypithecus_francoisi       HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
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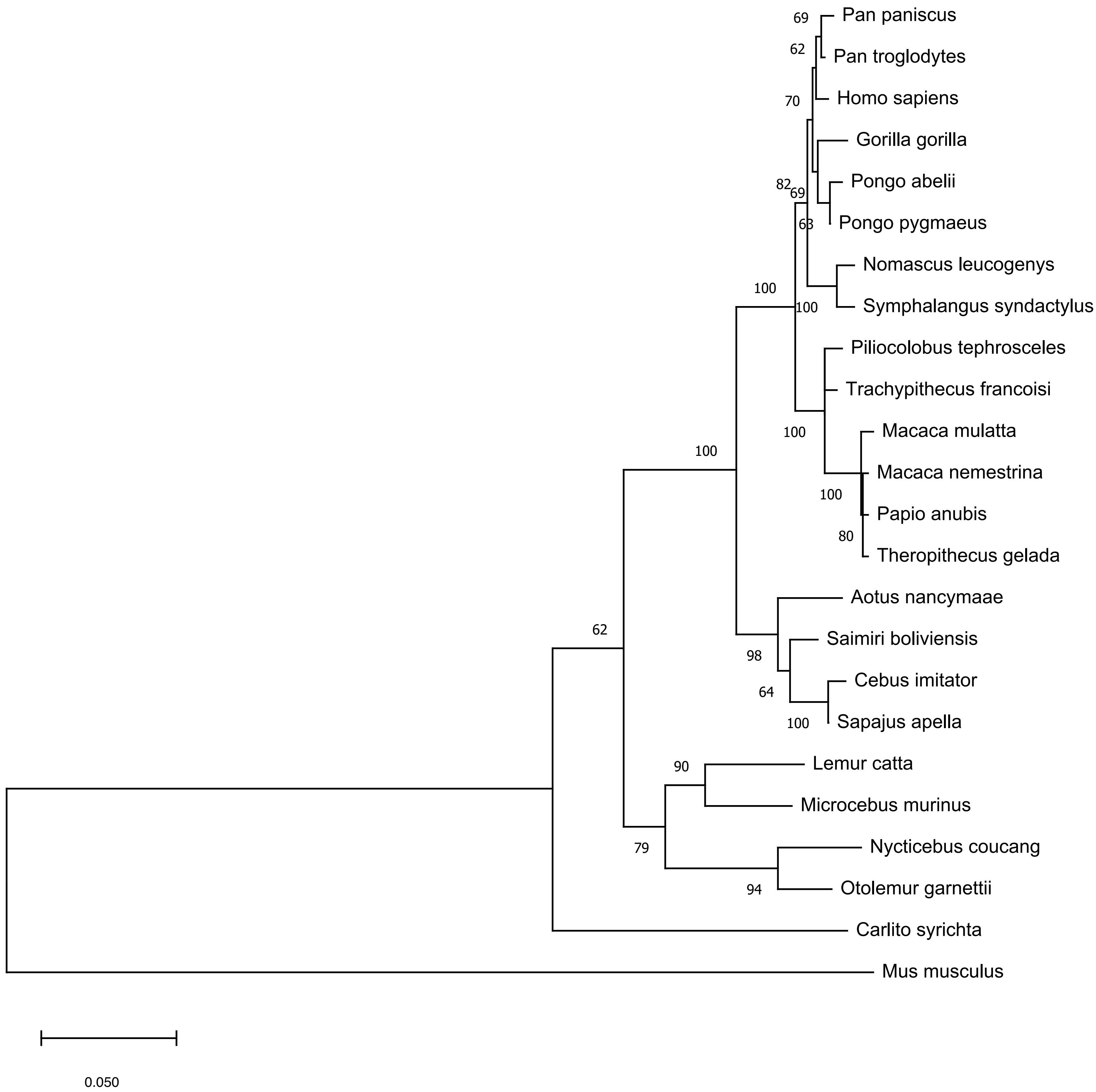
Pan paniscus
Pan troglodytes
Homo sapiens
Gorilla gorilla
Pongo abelii
Pongo pygmaeus
Nomascus leucogenys
Symphalangus syndactylus
Piliocolobus tephrosceles
Trachypithecus francoisi
Macaca mulatta
Macaca nemestrina
Papio anubis
Theropithecus gelada
Aotus nancymaae
Saimiri boliviensis
Cebus imitator
Sapajus apella
Lemur catta
Microcebus murinus
Nycticebus coucang
Otolemur garnettii
Carlito syrichta
Mus musculus
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Mus_musculus                     MFRLKTLPLL IFLHTQLANA FPVPEHLEEK NIKTAE---- -------NYLR KFYNLPSNQF RSSRN--ATM
Aotus_nancymaae                  MFCLKTLPFL LLLHVQISKA FPVSS--KEK DTKIVQ---- -------DYLE KFYQLPSNQY QSIRKNSINM
Carlito_syrichta                 MFSLQMLLFL LLLHMQVATA FPTPS--EEK STTMVQ---- -------DYLE KFYQLPSSRY RSARKNSTSM
Cebus_imitator                   MFCLKTLPFL LLLHVQISKA FPVSS--KEK DTKIVQ---- -------DYLE KFYQLPSNQH QSIRKNSINM
Gorilla_gorilla                  MFSLKTLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Lemur_catta                      MFYLKTLPFL LLLHMELSKA FPVPS--EEK NAKIVQ---- -------DYLE KFYRLPSNQY RTARKNSPST
Macaca_mulatta                   MFSLKMLLFL LLLHVQISKA FPVSS--KEE NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTSM
Macaca_nemestrina                ---------- -------MQQ IP-------- QEKSIN---- -------DYLE KFYQLPSNQY QSTRKNGTSM
Microcebus_murinus               MFCLKTLPLL LLLHMELSKA FPVPS--EGR NAKIVQ---- -------DYLE KFYRLPSNQY RTARKNSASM
Nomascus_leucogenys              MFALKTLPFL LLLHVHISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Nycticebus_coucang               MFCLKTLLFL LLLHVQLSKT FPVVS--AEK NTKLIQ---- -------DYLE KFYQLPSNRY RTSRKNSTTM
Otolemur_garnettii               MFRLKTLVFL LLLHVPLSKT FPVVS--AEK NTKLIQ---- -------DYLE KFYQLPSNRY RTSRKNSTTM
Pan_paniscus                     MFSLKTLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Pan_troglodytes                  MFSLKMLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Papio_anubis                     MFSLKMLPFL LLLHVQISKA FPVSS--KEE NTKIVQ---- -------DYLE KFYQLPSNQY QSMRKNGTSM
Piliocolobus_tephrosceles        MFSLKTLPFL FLLHVQISKA FPVSS--KEE NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTSM
Pongo_abelii                     MFSLKTLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Pongo_pygmaeus                   -MCRFPRPFL YLLKRKIQKL FSTRP--SQK PTRCSHLILD FPASKIDYLE KFYQLPSNQY QSTRKNGTNV
Saimiri_boliviensis              MFCLKRLPFL LLLHVQISKA FPVSF--KEK DTKIVQ---- -------DYLE KFYQLPSNQY QSIRKNSINM
Sapajus_apella                   MFCLKTLPFL LLLHVQISKA FPVSS--KEK DTKIVQ---- -------DYLE KFYQLPSNQY QSIRKNSINM
Symphalangus_syndactylus         MFALKTLPFL LLLHVHISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Theropithecus_gelada             MFSLKMLPFL LLLHVQISKA FPVSS--KEE NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTSM
Trachypithecus_francoisi         MFSLKTLPFL LLLHVQISKA FPLSS--KEE NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTSM
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Homo_sapiens                IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGG FMLTPGNPKW ERTNLTYRIR NYTPQLSEAE
Mus_musculus                VAEKLKEMQR FFSLAETGKL DAATMGIMEM PRCGVPDSGD FLLTPGSPKW THTNLTYRII NHTPQLSRAE
Aotus_nancymaae             IVEKLKEMQR FFGLNVTGKP NAETLEMMKQ PRCGVPDSGD FMITPGNPKW EQTNLTYRII NYTPQLSETE
Carlito_syrichta            IVEKLKEMQR FFGLNVTGKP DAETLETMEK PRCGVPDRGD FMLTPGNPKW KHTNLTYRII NYTPQLSEAD
Cebus_imitator              IVEKLKEMQQ FFGLNVTGKP NAETLEMMKQ PRCGVPDSGD FMITPGNPKW EQTNLTYRII NYTPQLSETE
Gorilla_gorilla             IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGG FMLTPGNPKW EHTNLTYRIR NYTPQLSVAE
Lemur_catta                 IVEKLKEMQR FFRLNVTGKP DAETLEVMEK PRCGVPDSGD FAITPGNPKW EHTNLTYRII SYTQQLSEAD
Macaca_mulatta              IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMLTPGNPKW ERTNLTYSIL NYTPQLSETD
Macaca_nemestrina           IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMLTPGNPKW ERTNLTYSIL NYTPQLSETD
Microcebus_murinus          VVEKLKEMQR FFGLNVTGKP DAETLEVMEK PRCGVPDSSS FMITPGSPKW EHTNVTYRII SHTQQLSVAE
Nomascus_leucogenys         IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMITPGNPKW ERTNLTYRIR NYTPQLSKAD
Nycticebus_coucang          IVEKLKEMQR FFGLNVTGKP NAETLEMMEK PRCGVPDTAG FVLTPGNPKW EHINLTYRFI NYTPQLSKTD
Otolemur_garnettii          IVEKLKEMQR FFGLNVTGKP NAETLEMMEK PRCGVPDTAG FMLTPGSPKW EHTNLTYRFI NYTPQLSKTD
Pan_paniscus                IIEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGG FMLTPGNPKW ERTNLTYRIR NYTPQLSEAE
Pan_troglodytes             IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGG FMLTPGNPKW EHTNLTYRIR NYTPQLSEAE
Papio_anubis                IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMLTPGNPKW EHTNLTYRIL NYTPQLSETD
Piliocolobus_tephrosceles   IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDTGD FMLTPGNPKW KHTNLTYSIL NYTPQLSQTD
Pongo_abelii                IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGE FMLTPGNPKW ERTNLTYRIR NYTPQLSEDD
Pongo_pygmaeus              IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGE FMLTPGNPKW ERTNLTYRIR NYTPQLSEDD
Saimiri_boliviensis         IVEKLKEMQR FFGLNVTGKP DAETLEMMKQ PRCGVPDSGD FMITPGNPKW EQTNLTYRFI NYTPQLSVTE
Sapajus_apella              IVEKLKEMQQ FFGLNVTGKP NAETLEMMKQ PRCGVPDSGD FMITPGNPKW EQTNLTYRII NYTPQLSETE
Symphalangus_syndactylus    IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMITPGNPKW ERTNLTYRIR NYTPQLSKTD
Theropithecus_gelada        IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMLTPGNPKW ERTNLTYRIL NYTPQLSETD
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Homo_sapiens                  VERAIKDAFE LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Mus_musculus                  VKTAIEKAFH VWSVASPLTF TEILQGEADI NIAFVSRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDS
Aotus_nancymaae               VETAIGNAFK VWSNASSLTF TRISQGEANI SIAFFHRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDA
Carlito_syrichta              VDSAIERAFE LWSHASPLRF TRISQGEPDI KIAFVQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Cebus_imitator                VERAIGDAFK VWSDVSPLTF TRISQGEADI NIAFYQKDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Gorilla_gorilla               VERAIKDAFE LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Lemur_catta                   VETAIEKAFK VWSDVSPLTF TRISRGEADI KIAFYLRDHG DNSPFDGPNG ILAHAFQPGR GIGGDVHFDA
Macaca_mulatta                VEGAIKKAFE VWSKASPLTF TRISQGQADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Macaca_nemestrina             VEGAIKKAFE VWSKASPLTF TRISQGQADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Microcebus_murinus            VGAAFEKAFK LWSGASPLTF TRISQGEADI KIAFVQRDHG DNSPFDGPNG ILAHAFQPGP GIGGDVHFDA
Nomascus_leucogenys           VERAIEKAFK VWSDASPLTF TRISQGEADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Nycticebus_coucang            VETVIEKAFE VWSKASPLTF TKISQGEADI KIAFVRREHG DNSPFDGPNG ILAHAFQPGR GIGGDVHFDE
Otolemur_garnettii            VETVIEKAFE VWSKASPLTF TKTAQGEADI KIAFVQKDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDE
Pan_paniscus                  VERAIKDAFK LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Pan_troglodytes               VERAIKDAFE LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Papio_anubis                  VEGAIKKAFE VWSKASPLTF TRISQGQADI NIGFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Piliocolobus_tephrosceles     VEGTIKKAFE VWSKVSPLTF TRISQGDADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Pongo_abelii                  VKTAIEKAFE VWSKASPLTF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDA
Pongo_pygmaeus                VKTAIEKAFE VWSKASPLTF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDA
Saimiri_boliviensis           VETAIGNAFK IWSDPSPLTF TRISQGEADI NIAFFPRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Sapajus_apella                VETAIGDAFK VWSDVSPLTF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Symphalangus_syndactylus      VERAIEKAFK VWSDASPLTF TRISQGEADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Theropithecus_gelada          VEGAIKKAFE VWSKASPLTF TRISQGQADI NIGFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Trachypithecus_francoisi      IEGAIKKAFE VWSKVSPLTF TRISQGEADI NIGFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
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Mus_musculus                    EETWTQDSKN YNLFLVAAHE FGHSLGLSHS TDPGALMYPN YAYREPSTYS LPQDDINGIQ TIYGPSDNPI
Aotus_nancymaae                 EETWTSTSKN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYS LPQDDINGIQ AIYGPSSNPI
Carlito_syrichta                EETWTKTSAN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYL LPQDDINGIQ AIYGPSDNPI
Cebus_imitator                  EETWTNTSEN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYS LPQDDINGIQ AIYGPSSNPI
Gorilla_gorilla                 EETWTNTSAS YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDIDGIQ AIYGLSSNPI
Lemur_catta                     EETWTTNANN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFREPSTYT LPQDDINGIQ AIYGPSSNPV
Macaca_mulatta                  EETWTKTSTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Macaca_nemestrina               EETWTKNSTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Microcebus_murinus              EETWTTNFNN YNLFLVAAHE FGHSLGLAHS SDAGALMYPN YAFSEPSTYT LPQDDINGIQ AIYGPSNNPI
Nomascus_leucogenys             EETWTKTSTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSTYS LPQDDIDGIQ AIYGPSSNPI
Nycticebus_coucang              EETWTTTAVN YNLFLVAAHE FGHSLGLSHS TDPGALMYPN YAFNDPSTYS LPQDDINGIQ AIYGPSSSPV
Otolemur_garnettii              EETWTTTSIN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFNEPSTYS LPQDDINGIQ AIYGPSNSPV
Pan_paniscus                    EETWTDTSAN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDIDGIQ AIYGLSSNPI
Pan_troglodytes                 EETWTDTSAN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDIDGIQ AIYGLSSNPI
Papio_anubis                    EETWTKDFTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Piliocolobus_tephrosceles       EETWTTNSTN YNLFLVAAHE FGHSLGLAHS FDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Pongo_abelii                    EETWTKTSAN YNLFIVAAHE FGHSLGLAHS SDPGALMYPN YAFTETSNYS LPQDDIDGIQ AIYGPSSNPV
Pongo_pygmaeus                  EETWTKTSAN YNLFIVAAHE FGHSLGLAHS SDPGALMYPN YAFTETSNYS LPQDDIDGIQ AIYGPSSNPV
Saimiri_boliviensis             EETWTSTSEN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYS LPQDDINGIQ AIYGPSSNPI
Sapajus_apella                  EETWTNTPEN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYS LPQDDINGIQ AIYGPSSNPI
Symphalangus_syndactylus        EETWTKTSAN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSTYS LPQDDIDGIQ AIYGPSSNPI
Theropithecus_gelada            EETWTKDFTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Trachypithecus_francoisi        EETWTTNSTN YNLFLVAAHE FGHSLGLAHS FDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
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Homo_sapiens                  QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Mus_musculus                  QPTGPSTPKA CDPHLRFDAT TTLRGEIYFF KDKYFWRRHP QLRTVDLNFI SLFWPFLPNG LQAAYEDFDR
Aotus_nancymaae               QPTGPSTPRP CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Carlito_syrichta              QPTGPSTPRT CDPRLTFDAI TTLRGEIFFF RDKYFWRRHP QLRSIEFNFI SLFWPALPDS IQAAYEDLDR
Cebus_imitator                QPTGPSTPRP CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Gorilla_gorilla               QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Lemur_catta                   QPTGPSTPRS CDPRLTFDAI TTLRGEILFF KDKYFWRRHP QLRSVELNFI SLFWPNLPNG IQAAYEDFDR
Macaca_mulatta                QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Macaca_nemestrina             QPTGPTTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Microcebus_murinus            QPTGPSTPMA CDPRLTFDAI TTLRGEIFFF KDKYFWRRHP QLRSVELNFI SLFWPSLPNG IQAAYEDFDK
Nomascus_leucogenys           QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDSDR
Nycticebus_coucang            QPTGPSTPRT CDPRLTFDAI TTLRGEILFF KDKYFWRKHP QLPTVELNFI SLFWPSLPNG IQAAYEDFDR
Otolemur_garnettii            QPTGPSTPRT CDPRLTFDAI TTLRGEILFF KDKYFWRKHP QLPTAELNFI SLFWPSLPNG IQAAYEDFER
Pan_paniscus                  QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Pan_troglodytes               QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Papio_anubis                  QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Piliocolobus_tephrosceles     QPTGPSTPES CDPRLTFDAI TTLRGEILFF KDEYFWRRHP WLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Pongo_abelii                  QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRIEMNFI SLFWPSLPTG MQAAYEDFDR
Pongo_pygmaeus                QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRIEMNFI SLFWPSLPTG MQAAYEDFDR
Saimiri_boliviensis           QPTGPSTPRS CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLRRVEMNFI SLFWPSLPTG IQAAYEDFDR
Sapajus_apella                QPTGPSTPRP CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Symphalangus_syndactylus      QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Theropithecus_gelada          QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Trachypithecus_francoisi      QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
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Mus_musculus                 DLVFLFKGRQ YWALSGYDLQ QGYPRDISNY GFPRSVQAID AAVSYNGKTY FFINNQCWRY DNQRRSMDPG
Aotus_nancymaae              DLVFLFKGNQ YWALSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Carlito_syrichta             DLVFLFKGNQ YWAMNGYDLQ PGYPRDISNY GFPSNVQAID AAVYFRSKTY FFVNDQFWRY DNERQTMEPG
Cebus_imitator               DLVFLFKGNQ YWALSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQLMEPG
Gorilla_gorilla              DLIFLFKGNQ YWALSGYDIL QGYPKDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Lemur_catta                  DLVFLFKGNQ YWALSGYDIQ QGYPRYISNY GFPSTVQAID AAVSYGSETY FFVNDQFWRY DNQRQAMDPG
Macaca_mulatta               DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Macaca_nemestrina            DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Microcebus_murinus           DLVFLFKGNQ YWAMSGYDIQ QGYPRHISNY GFPSNVQAID AAVSYGRKTY FFVNDQLWRY DNQRQAMDPG
Nomascus_leucogenys          DLIFLFKGNQ YWALSGYDIQ QGYPKSISNY GFPCSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Nycticebus_coucang           DLVFLFKGNQ YWALNGYDIQ EGYPRDISNY GFPSTVQAID AAVSYRRKTY FFVNDQFWRY DNQRQLMEPG
Otolemur_garnettii           DLVFLFKGNQ YWALNGYEIQ QGYPRDISNY GFPSTVQAVD AAVFYRRKTY FFVNDQFWRY DNQRQFMEPG
Pan_paniscus                 DLIFLFKGNQ YWALSGYDIL QGYPKDIANY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Pan_troglodytes              DLIFLFKGNQ YWALSGYDIL QGYPKDIANY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Papio_anubis                 DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Piliocolobus_tephrosceles    DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Pongo_abelii                 DLIFLFKGNQ YWALSGYDIL QGYPKNISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Pongo_pygmaeus               DLIFLFKGNQ YWALSGYDIL QGYPKNISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Saimiri_boliviensis          DLVFLFKGNQ YWALSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYKSKTY FFVNDQFWRY DNQRQFMEPG
Sapajus_apella               DLVFLFKGNQ YWALSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQLMEPG
Symphalangus_syndactylus     DLIFLFKGNQ YWALSGYDIQ QGYPKSISNY GFPCSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Theropithecus_gelada         DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Trachypithecus_francoisi     DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
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Homo_sapiens              YPKSISGAFP GIESKVDAVF QQEHFFHVFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Mus_musculus              YPKSIPSMFP GVNCRVDAVF LQDSFFLFFS GPQYFAFNFV SHRVTRVARS NLWLNCS--
Aotus_nancymaae           YPQSISYIFP GIESKVDAVF QQEHFFLFFS GPLYYAFDLS AQRVTRVARG NKWLNCR--
Carlito_syrichta          YPKSTLSIFP GIESKVDAVF QQNYFFFFFS GPRFYAFDLQ AHRVTRVDRS NRWLNCR--
Cebus_imitator            YPQRISDIFP GIERKVDAVF QQEHFFLFFS GPIYYAFDLS AQRVTRVARG NKWLNCR--
Gorilla_gorilla           YPKSISGAFP GIESKVDAVF QQQHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Lemur_catta               YPQSILRTFP GIQSKVDAVF QKDDFFLFFS GPLYYAFNLS TRRVTRIDRS NKWLNCR--
Macaca_mulatta            YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Macaca_nemestrina         YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Microcebus_murinus        YPQSISSTFP GIQSRVDAVF QQDDFFLFFS GPRYYAFNLS TNRVTRLDKS NKWLNCR--
Nomascus_leucogenys       YPKSISGTFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVERG NKWLNCRYG
Nycticebus_coucang        YPKSLSTAFP GIESRVDAVF QRDYVFLFFS GPRYYAFDLN TRRVIRIDRS NIWLNCR--
Otolemur_garnettii        YPKSISTAFP GIESRVDAVF HRDYVFVFFS GPRYYAFDLN TRRVIRIDRS NKWLNCR--
Pan_paniscus              YPKSISGAFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Pan_troglodytes           YPKSISGAFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Papio_anubis              YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Piliocolobus_tephrosceles YPKSTSGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTTVARA NEWLNCRYS
Pongo_abelii              YPKSISDTFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Pongo_pygmaeus            YPKSISDTFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCR--
Saimiri_boliviensis       YPQSISGIFP GIESKVDAVF QQEHFFLFFS GPIYYAFDLS AQRVTKIARG NKWLNCR--
Sapajus_apella            YPQRISDIFP GIERKVDAVF QQEHFFLFFS GPIYYAFDLS AQRVTRVARG NKWLNCR--
Symphalangus_syndactylus  YPKSISDTFP GIESKVDAVF QQERFFLFFS GPRYYAFDLI AQRVTRVERG NKWLNCRYG
Theropithecus_gelada      YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Trachypithecus_francoisi  YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
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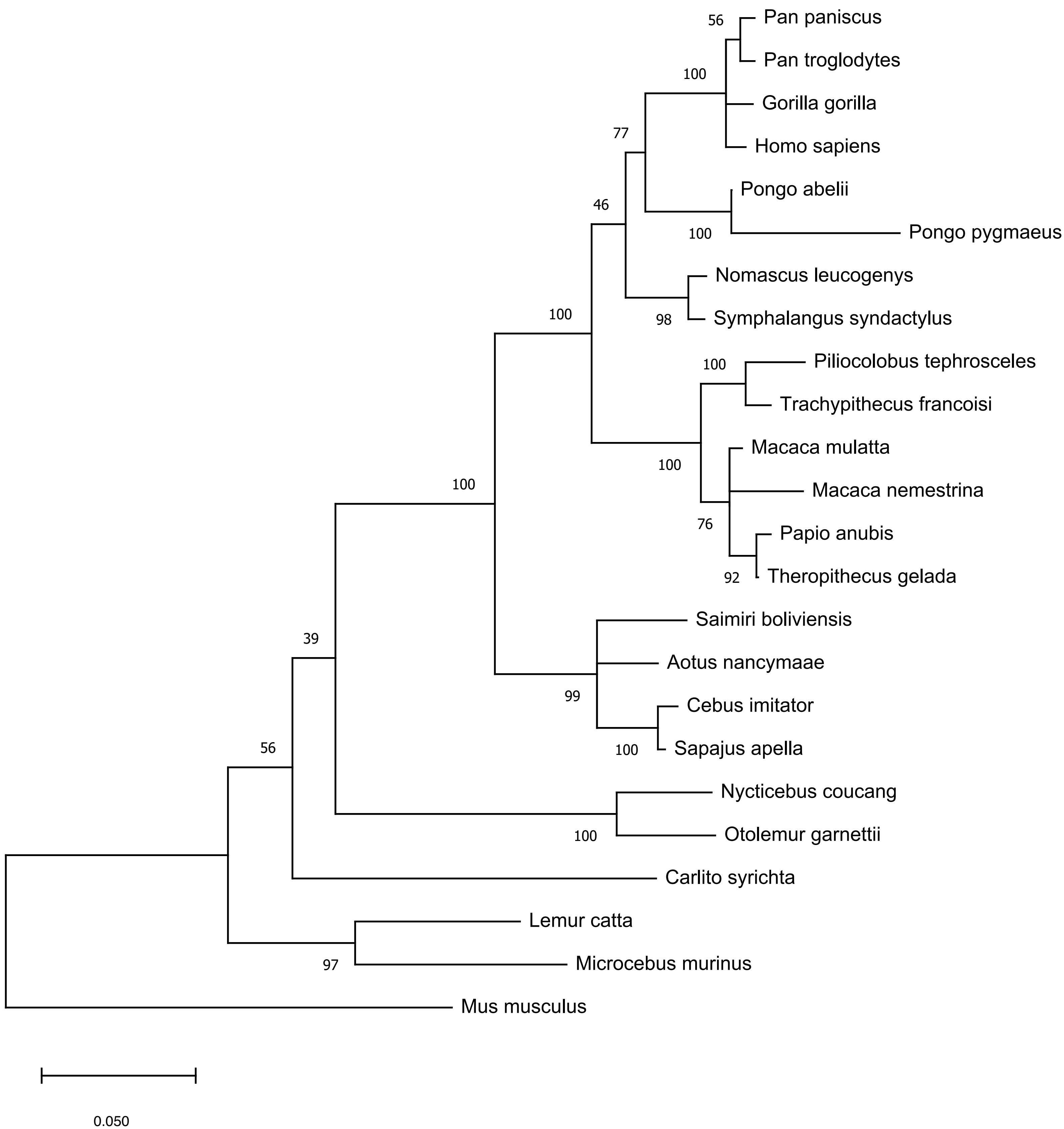
56
Pan paniscus
Pan troglodytes
100
Gorilla gorilla
Homo sapiens
77
Pongo abelii
46
Pongo pygmaeus
100
Nomascus leucogenys
100
98
Symphalangus syndactylus
100
Piliocolobus tephrosceles
Trachypithecus francoisi
Macaca mulatta
100
100
Macaca nemestrina
76
Papio anubis
92
Theropithecus gelada
Saimiri boliviensis
39
Aotus nancymaae
99
Cebus imitator
56
100
Sapajus apella
Nycticebus coucang
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Otolemur garnettii
Carlito syrichta
Lemur catta
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Microcebus murinus
Mus musculus
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Mus_musculus                  MHSAILATFF LLSWTPCWSL PLPYGDDDDD DLSEEDLVFA EHYLKSYYHP ATLAGILKKS TVTSTVDRLR
Aotus_nancymaae               MHLGVLAAFL FLNWTHCRAL PLPNG-DDED DLSEEDLQFA ERYLKLYYHP TNLAGILKKN SANSMADRLR
Carlito_syrichta              MHPGVLTAFL LLCWTQCQSL PLPNG-EDED DTSEEDLQFA ERYLRSFYHP VNLAGILKKN AASSMVDRLR
Cebus_imitator                MHPGVLAAFL FLSWTHCWAL PLPNG-DDED DLSEEDLQFA ERYLKLYYHP TNLAGILKKN SASSMTDRLR
Gorilla_gorilla               MHPGVLAAFL FLSWTHSRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Lemur_catta                   MHPGILVAFL FLSWTHCRSL PLPNG--DDD DLSEEDLQFA ERYLKSYYHP PNLAGILKET SASSMVDRLR
Macaca_mulatta                MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Macaca_nemestrina             MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Microcebus_murinus            -MQGVLVAFL FLSWTHCRSL PLPDG--DDD DLSEEDLQFA ERYLKSYYHP PILAGILKKT SASSMVDRLR
Nomascus_leucogenys           MHPGILAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Nycticebus_coucang            MLPGVLLAFL FLSWTHCRAL PLPND-DDDD DLSEEDLQFA ERYLKSYYYP PNLAGILKKT SASSMIDRLR
Otolemur_garnettii            MLPRVLLAFL FLSWTPCRAL PLPNG--DDD DLSEEDLQFA EHYLKSYYHP LNLAGILKKT SASSMIDRLR
Pan_paniscus                  MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTERLR
Pan_troglodytes               MHPGVLAAFL FLSWAHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTERLR
Papio_anubis                  MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Piliocolobus_tephrosceles     MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Pongo_abelii                  MHPGVLAAFL FLSWTHCRAL PLPSD-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Pongo_pygmaeus                MHPGVLAAFL FLSWTHCRAL PLPSD-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Saimiri_boliviensis           MHPGVLAAFL FLSWTHCRAL PLPNG-DDED DLSEEDLQFA ERYLKLYYHP TNLAGILKKN SASSMTDRLR
Sapajus_apella                MHPGVLAAFL FLSWTHCWAL PLPNG-DDED DLSEEDLQFA EHYLKLYYHP TNLAGILKKN SASSMTDRLR
Symphalangus_syndactylus      MHPGILAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Theropithecus_gelada          MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Trachypithecus_francoisi      MHPVVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
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71

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Homo_sapiens | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Mus_musculus | EMQSFFGLEV | TGKLDDPTLD | IMRKPRCGVP | DVGEYNVFPR | TLKWSQTNLT | YRIVNYTPDM | SHSEVEKAFR |
| Aotus_nancymaae | EMQSFFGLEV | TGKLDDNTLD | IMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Carlito_syrichta | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIENYTPDM | PHSEVEKAFK |
| Cebus_imitator | EMQSFFGLEV | TGKLDDNTLD | IMKKPRCGVP | DVGEYNVFPR | TLKWPKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Gorilla_gorilla | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Lemur_catta | EMQSFFGLEV | TGKLDDNTLD | IMKKPRCGVP | DVGEYNVFPR | TLKWTQTNLT | YRIVNYTPDM | PHSEVEKAFK |
| Macaca_mulatta | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Macaca_nemestrina | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Microcebus_murinus | EMQSFFGLEV | TGKLDDNTLD | IMKKPRCGVP | DVGEYNVFPR | TLKWTQTNLT | YRIVNYTPDM | THSEVEKAFK |
| Nomascus_leucogenys | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Nycticebus_coucang | EMQSFFGLEV | TGKLDDNTLD | IMKKPRCGVP | DVGEYNVFPR | TLKWTKTNLT | YRIVNYTPDM | THSEVEKAFK |
| Otolemur_garnettii | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWTKTNLT | YRIVNYTPDM | THSEVEKAFK |
| Pan_paniscus | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Pan_troglodytes | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Papio_anubis | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Piliocolobus_tephrosceles | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Pongo_abelii | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Pongo_pygmaeus | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Saimiri_boliviensis | EMQSFFGLEV | TGKLDDNTLD | IMKKPRCGVP | DVGEYNVFPR | TLKWSRMNLT | YRIVNYTPDM | THSEVEKAFK |
| Sapajus_apella | EMQSFFGLEV | TGKLDDNTLD | IMKKPRCGVP | DVGEYNVFPR | TLKWPKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Symphalangus_syndactylus | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Theropithecus_gelada | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Trachypithecus_francoisi | EMQSFFGLEV | TGKLDDNTLD | IMKKPRCGVP | DVGEYNVFPR | TLKWSKVNLT | YRIVNYTPDM | THSEVEKAFK |

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Homo_sapiens                  KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Mus_musculus                  KAFKVWSDVT PLNFTRIYDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Aotus_nancymaae               KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Carlito_syrichta              KAFKVWSDVT PLNFTRMHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Cebus_imitator                KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Gorilla_gorilla               KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Lemur_catta                   KAFKVWSDVT PLNFTRLHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Macaca_mulatta                KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Macaca_nemestrina             KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Microcebus_murinus            KAFKVWSDVT PLNFTRLHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNLGGDA HFDDDETWTS
Nomascus_leucogenys           KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Nycticebus_coucang            KAFKVWSDVT PLNFTRLHDG TADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Otolemur_garnettii            KAFKVWADVT PLNFTRLHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pan_paniscus                  KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pan_troglodytes               KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Papio_anubis                  KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Piliocolobus_tephrosceles     KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pongo_abelii                  KAFKVWSDVT PLNFTRLHNG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pongo_pygmaeus                KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Saimiri_boliviensis           KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Sapajus_apella                KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Symphalangus_syndactylus      KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Theropithecus_gelada          KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Trachypithecus_francoisi      KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
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| | 211 | | | | | | |
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| Homo_sapiens | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Mus_musculus | SSKGYNLFIV | AAHELGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQFLYGPG | DEDPNPKHPK |
| Aotus_nancymaae | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQFLYGPG | DEDPNPKHPK |
| Carlito_syrichta | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | NHFVLPDDDV | QGIQTLYGPG | DEDPNPKHPK |
| Cebus_imitator | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTSK | SHFMLPDDDV | QGIQFLYGPG | DEDPNPKHPK |
| Gorilla_gorilla | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Lemur_catta | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFVLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Macaca_mulatta | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Macaca_nemestrina | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Microcebus_murinus | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFVLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Nomascus_leucogenys | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Nycticebus_coucang | SSKGYNLFLV | AAHELGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPEDDV | QGIQFLYGPG | DEDPNPKHPK |
| Otolemur_garnettii | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFVLPEDDV | QGIQSLYGPG | DEDPNPKHPK |
| Pan_paniscus | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Pan_troglodytes | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Papio_anubis | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFVLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Piliocolobus_tephrosceles | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Pongo_abelii | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Pongo_pygmaeus | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Saimiri_boliviensis | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTSK | NHFMLPDDDV | QGIQFLYGPG | DEDPNPKHPK |
| Sapajus_apella | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTSK | SHFMLPDDDV | QGIQFLYGPG | DEDPNPKHPK |
| Symphalangus_syndactylus | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Theropithecus_gelada | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFVLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Trachypithecus_francoisi | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |

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Mus_musculus                  TPEKCDPALS LDAITSLRGE TMIFKDRFFW RLHPQQVEAE LFLTKSFWPE LPNHVDAAYE HPSRDLMFIF
Aotus_nancymaae               TPDKCDPSLS LDAITSLRGE TMVFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSRDLIFIF
Carlito_syrichta              TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSRDLIFIF
Cebus_imitator                TPDKCDPSLS LDAITSLRGE TMVFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Gorilla_gorilla               TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSYDLIFVF
Lemur_catta                   TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPAHDLVFVF
Macaca_mulatta                TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Macaca_nemestrina             TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Microcebus_murinus            TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLVFFF
Nomascus_leucogenys           TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Nycticebus_coucang            TPDKCDPSLS LDAITSLRGE TIIFKDRFFW RLHPQQVDAE LFLTKSFWME LPNRIDAAYE HPSHDLVFIF
Otolemur_garnettii            TPDKCDPSLS LDAITNLRGE TIIFKDRFFW RLHPQQVDAE LFLTKSFWLE LPNRIDAAYE HPSHDLVFIF
Pan_paniscus                  TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Pan_troglodytes               TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Papio_anubis                  TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Piliocolobus_tephrosceles     TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Pongo_abelii                  TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Pongo_pygmaeus                TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Saimiri_boliviensis           TPDKCDPSLS LDAITSLRGE TMVFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Sapajus_apella                TPDKCDPSLS LDAITSLRGE TMVFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Symphalangus_syndactylus      TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Theropithecus_gelada          TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Trachypithecus_francoisi      TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
```

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Mus_musculus                  RGRKFWALNG YDILEGYPRK ISDLGFPKEV KRLSAAVHFE NTGKTLFFSE NHVWSYDDVN QTMDKDYPRL
Aotus_nancymaae               RGRKFWALNG YDILEGYPKK ISELGFPKEI KKISAAVHFE DTGRTLFFSG NHVWRYDDTN QIMDKDYPRL
Carlito_syrichta              RGRKFWALNG YDIMEGYPQK ISELGFPKEV KKISAAVHFE DTGKTLFFSG NQVWSYDDTN HVMDKDYPRF
Cebus_imitator                RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGRTLFFSG NQVWRYDDTN QIMDKDYPRL
Gorilla_gorilla               RGRKFWALNG YDILEGYPKK ISELGLPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
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Macaca_mulatta                RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Macaca_nemestrina             RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Microcebus_murinus            RGRKFWALNG YDIMEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLFFSG NQVWRYDDTN QIMDKDYPRL
Nomascus_leucogenys           RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Nycticebus_coucang            RGRKFWALNG YDIMEGYPKK ISELGFPKEV KKISAAVHFE DRGKTLFFSG NQVWSYDDTN HIMDKDYPRL
Otolemur_garnettii            RGRKFWALNG YDIMEGYPKK ISELGFPKEV KKISAAVHFE DRGKTLFFSG NQVWSYDDTN HIMDKDYPRL
Pan_paniscus                  RGRKFWALNG YDILEGYPKK ISELGLPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Pan_troglodytes               RGRKFWALNG YDILEGYPKK ISELGLPKEV KKISATVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Papio_anubis                  RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Piliocolobus_tephrosceles     RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Pongo_abelii                  RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Pongo_pygmaeus                RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Saimiri_boliviensis           RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLFFSG NQVWRYDDTN QIMDKDYPRL
Sapajus_apella                RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGRTLFFSG NQVWRYDDTN QIMDKDYPRL
Symphalangus_syndactylus      RGRKFWALNG YDILEGYPQK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Theropithecus_gelada          RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Trachypithecus_francoisi      RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
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Aotus_nancymaae                IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSKRI VRVMPANSIL
Carlito_syrichta               IEEVFPGIGD KVDAVYEKNG YIYFFNGPIQ FEF------- ---------- ---SVWSKRI VRVMTANSLL
Cebus_imitator                 IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSKRI VRVMPANSIL
Gorilla_gorilla                IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Lemur_catta                    IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPTNSLL
Macaca_mulatta                 IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Macaca_nemestrina              IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Microcebus_murinus             IEEDFPGIGD KVDAVYEKNG YIYFFSGPIQ FEY------- ---------- ---SIWSNRI VRVMPTNSLL
Nomascus_leucogenys            IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Nycticebus_coucang             IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSDRI VRVMPTNALL
Otolemur_garnettii             IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPTNALL
Pan_paniscus                   IEEEFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Pan_troglodytes                IEEEFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
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Saimiri_boliviensis            IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSKRI VRVMPANSIL
Sapajus_apella                 IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSKRI VRVMPANSIL
Symphalangus_syndactylus       IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Theropithecus_gelada           IEEDFPGIGD KVDAVYEKNE SHFVVQAGVQ WHNLSSLQPP PPGFKRFSCL SLRSSWNYRL YLFFQRAHTV
Trachypithecus_francoisi       IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
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Homo_sapiens                  WC
Mus_musculus                  WC
Aotus_nancymaae               WC
Carlito_syrichta              WC
Cebus_imitator                WC
Gorilla_gorilla               WC
Lemur_catta                   WC
Macaca_mulatta                WC
Macaca_nemestrina             LC
Microcebus_murinus            WC
Nomascus_leucogenys           WC
Nycticebus_coucang            WC
Otolemur_garnettii            WC
Pan_paniscus                  WC
Pan_troglodytes               WC
Papio_anubis                  WC
Piliocolobus_tephrosceles     WC
Pongo_abelii                  WC
Pongo_pygmaeus                WC
Saimiri_boliviensis           WC
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Symphalangus_syndactylus      WC
Theropithecus_gelada          --
Trachypithecus_francoisi      WC
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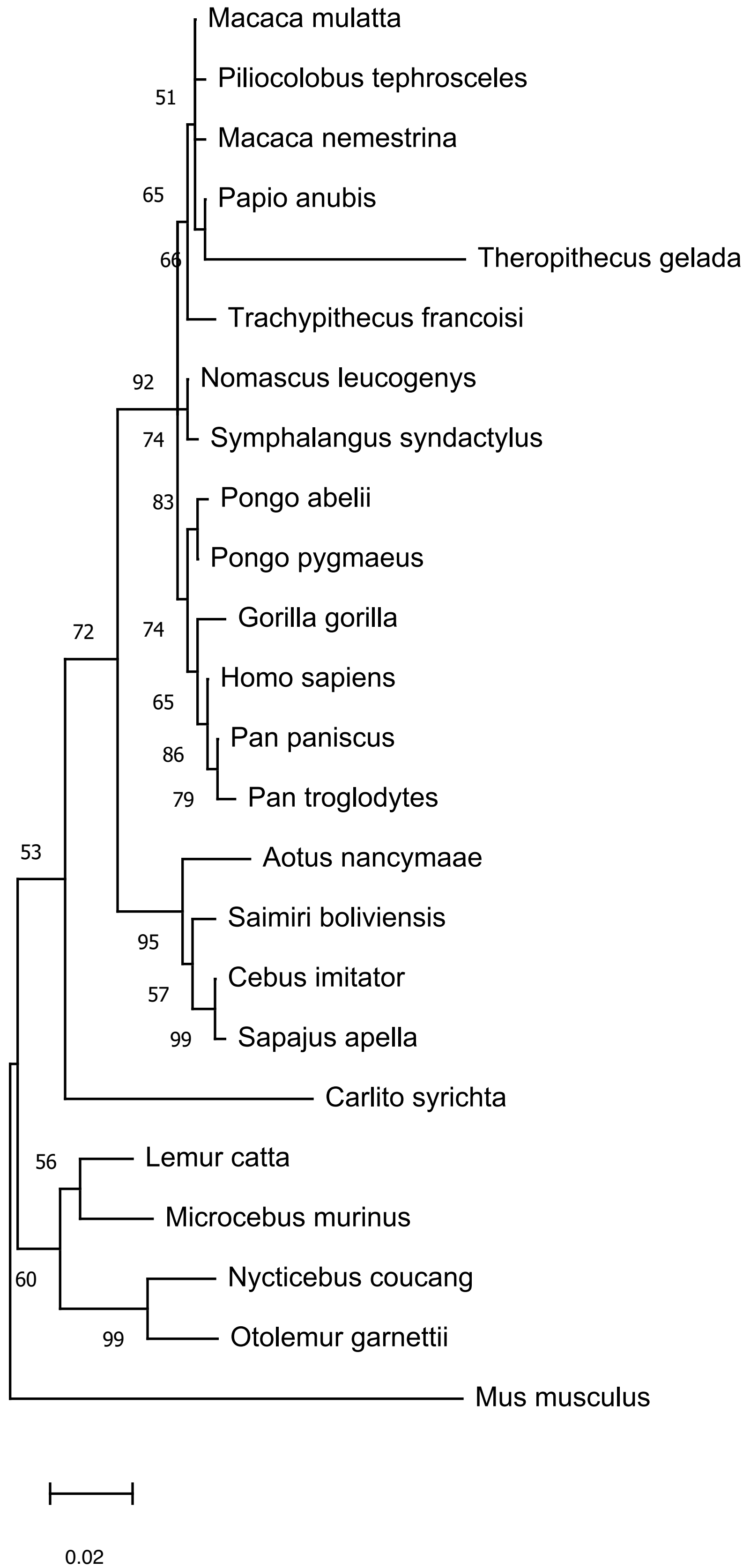
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Macaca nemestrina
Papio anubis
Theropithecus gelada
Trachypithecus francoisi
Nomascus leucogenys
Symphalangus syndactylus
Pongo abelii
Pongo pygmaeus
Gorilla gorilla
Homo sapiens
Pan paniscus
Pan troglodytes
Aotus nancymaae
Saimiri boliviensis
Cebus imitator
Sapajus apella
Carlito syrichta
Lemur catta
Microcebus murinus
Nycticebus coucang
Otolemur garnettii
Mus musculus
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A glimpse on the discussions…

# A STUDY ON GRASSHOPPER DIVERSITY IN CHRIST COLLEGE (AUTONOUMOUS), IRINJALAKUDA

**DEPARTMENT OF ZOOLOGY,**
**CHRIST COLLEGE (AUTONOMOUS),**
**IRINJALAKUDA**
**THRISSUR, KERALA-680 125**

**MARCH 2024**

# A STUDY ON GRASSHOPPER DIVERSITY IN CHRIST COLLEGE IRINJALAKUDA

***Project report submitted to the University of Calicut in partial fulfillment of the requirement for the award of the Degree***

## BACHELOR OF SCIENCE
## IN ZOOLOGY

| Sl No. | Group members | Register No. |
|---|---|---|
| 1. | AKSHAY K A | CCAVSZO002 |
| 2. | ALEENA MARIYA | CCAVSZO016 |
| 3. | ANAGHA ARUN M A | CCAVSZO004 |
| 4. | ANAGHA SAIBU | CCAVSZO018 |
| 5. | ANJIMA JOSE | CCAVSZO020 |
| 6. | MARIYA T J | CCAVSZO028 |
| 7. | NEETHU N M | CCAVSZO009 |
| 8. | RAHMA | CCAVSZO011 |
| 9 | SANDRA K SHAJU | CCAVSZO032 |

**DEPARTMENT OF ZOOLOGY**
**CHRIST COLLEGE (AUTONOMOUS) IRINJALAKUDA**
**THRISSUR, KERALA 680125**

**Examiners:**

**1.** **2.**

# DECLARATION

We, Akshay K A, Aleena Mariya, Anagha Arun M A, Anagha Saibu, Anjima Jose, Mariya T J, Neethu N M, Rahma and Sandra K Shaju, do hear by declare that this project entitled "**Study on grasshopper diversity in Christ College (Autonomous), Irinjalakuda**" is a genuine record of project work done by us under the guidance of Dr. Bijoy C., Assistant Professor, Department of Zoology, Christ College (Autonomous), Irinjalakuda, and has not been submitted to any university or Institution for the Award of any Degree or Diploma.

We further declare that results presented in this work and considerations made therein, contribute in general to the advancement of knowledge in science.

| Sl. No | Register Number | Name | Signature |
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| 8 | CCAVSZO011 | RAHMA | |
| 9 | CCAVSZO032 | SANDRA K SHAJU | |

Place: Irinjalakuda

Date:

SHADPADA
ENTOMOLOGY
RESEARCH
LAB

Christ College (Autonomous),
Irinjalakuda, Thrissur- 680 125

Dr Bijoy C.
Assistant Professor,
Research Department of Zoology,
drbijoyc@gmail.com
Mob: 9895551003

# CERTIFICATE

This is to certify that the content of this project work entitled "**STUDY ON GRASSHOPPER DIVERSITY IN CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA**" is an original work done by the following students under my supervision and guidance at the Department of Zoology, Christ College (Autonomous), Irinjalakuda. I further certify that no part of the work has been presented for the award of any other Degree or Diploma.

| Sl. No | Register Number | Group members |
|---|---|---|
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| 9 | CCAVSZO032 | SANDRA K SHAJU |

**Place:** Irinjalakuda **Dr. Bijoy C.**

**Date:** Project Supervisor

## CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA

## DEPARTMENT OF ZOOLOGY

# CERTIFICATE

This is to certify that the project work entitled **'A study on grasshopper diversity in Christ College (Autonomous) Irinjalakuda'** is an authentic record of research work carried out by **Akshay K A, Aleena Mariya, Anagha Arun M A, Anagha Saibu, Anjima Jose, Mariya T J, Neethu N M, Rahma** and **Sandra K Shaju** as a part of B.Sc. practical during the year 2022- 2023 and the results of this work has not been presented for the award of any other degree/diploma in any university.

Place: Irinjalakuda

Date:

**Dr. Sudhikumar A. V.**

Head, Department of Zoology,

Christ College, Irinjalakuda

# ACKNOWLEDGMENTS


The success and final outcome of this project required a lot of guidance and assistance from people. Whatever we have done is only due to such guidance and assistance and we would like to express our gratitude to the following individuals without whom the work would not have been completed.

Firstly, we would like to express our heartfelt gratitude to the Almighty for providing us with the strength, wisdom, and perseverance throughout the course of this project.

We would like to express our sincere gratitude to Dr Bijoy C, Assistant Professor, Department of Zoology, Christ College, Irinjalakuda, for providing necessary advice, for his patience in bearing our ideas, and for all the efforts he made to see this project through to completion. This study would not be possible without his tremendous help and guidance. His dedication to academic excellence has been truly inspiring.

We are deeply indebted to Dr A.V. Sudhikumar, Head of Department of zoology, Christ College, Irinjalakuda, as well as all other teaching and non-teaching department personnel, for the suggestions.

We are also grateful to Rev. Dr Jolly Andrews CMI, Principal of Christ College Irinjalakuda, for providing all available resources for this project and for fostering an environment of learning and excellence at college.

We are immensely grateful to Ms. Thasnim E S, Research scholar at Shadpada Entomology Research Lab (SERL), Christ College, Irinjalakuda, for the identification of specimens, providing necessary ideas from the start of this project and for her valuable insights, and contributions to this project. Her dedication and expertise have been invaluable assets throughout the process.

Lastly, we extend our heartfelt thanks to our family for their encouragement, and support during the field trips.

# CONTENTS

## ABSTRACT

The present study is an attempt to find the diversity of grasshoppers in Christ College campus, to calculate the relative abundance of collected grasshoppers and to study their variations according to seasons and habitats. The study was carried out in four sites of Christ College campus, Irinjalakuda, Thrissur district, Kerala. Collection was done on two different seasonal period from monsoon to post monsoon. Post monsoon has the maximum species richness and monsoon shows more species diversity. According to our study, we observed 19 grasshopper species, Family Acrididae is the most abundant and Family Tetrigidae has the least abundance.

# A STUDY ON GRASSHOPPER DIVERSITY IN CHRIST COLLEGE (AUTONOUMOUS), IRINJALAKUDA

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**MARCH 2024**

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**DEPARTMENT OF ZOOLOGY**
**CHRIST COLLEGE (AUTONOMOUS) IRINJALAKUDA**
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Place: Irinjalakuda

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Dr Bijoy C.
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drbijoyc@gmail.com
Mob: 9895551003

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| 8 | CCAVSZO011 | RAHMA |
| 9 | CCAVSZO032 | SANDRA K SHAJU |

**Place:** Irinjalakuda

**Date:**

**Dr. Bijoy C.**

Project Supervisor

# CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA

## DEPARTMENT OF ZOOLOGY

## CERTIFICATE

This is to certify that the project work entitled **'A study on grasshopper diversity in Christ College (Autonomous) Irinjalakuda'** is an authentic record of research work carried out by **Akshay K A, Aleena Mariya, Anagha Arun M A, Anagha Saibu, Anjima Jose, Mariya T J, Neethu N M, Rahma** and **Sandra K Shaju** as a part of B.Sc. practical during the year 2022- 2023 and the results of this work has not been presented for the award of any other degree/diploma in any university.

Place: Irinjalakuda

Date:

**Dr. Sudhikumar A. V.**

Head, Department of Zoology,

Christ College, Irinjalakuda

## ACKNOWLEDGMENTS

The success and final outcome of this project required a lot of guidance and assistance from people. Whatever we have done is only due to such guidance and assistance and we would like to express our gratitude to the following individuals without whom the work would not have been completed.

Firstly, we would like to express our heartfelt gratitude to the Almighty for providing us with the strength, wisdom, and perseverance throughout the course of this project.

We would like to express our sincere gratitude to Dr Bijoy C, Assistant Professor, Department of Zoology, Christ College, Irinjalakuda, for providing necessary advice, for his patience in bearing our ideas, and for all the efforts he made to see this project through to completion. This study would not be possible without his tremendous help and guidance. His dedication to academic excellence has been truly inspiring.

We are deeply indebted to Dr A.V. Sudhikumar, Head of Department of zoology, Christ College, Irinjalakuda, as well as all other teaching and non-teaching department personnel, for the suggestions.

We are also grateful to Rev. Dr Jolly Andrews CMI, Principal of Christ College Irinjalakuda, for providing all available resources for this project and for fostering an environment of learning and excellence at college.

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The present study is an attempt to find the diversity of grasshoppers in Christ College campus, to calculate the relative abundance of collected grasshoppers and to study their variations according to seasons and habitats. The study was carried out in four sites of Christ College campus, Irinjalakuda, Thrissur district, Kerala. Collection was done on two different seasonal period from monsoon to post monsoon. Post monsoon has the maximum species richness and monsoon shows more species diversity. According to our study, we observed 19 grasshopper species, Family Acrididae is the most abundant and Family Tetrigidae has the least abundance.

# A STUDY ON GRASSHOPPER DIVERSITY IN CHRIST COLLEGE (AUTONOUMOUS), IRINJALAKUDA

DEPARTMENT OF ZOOLOGY,
CHRIST COLLEGE (AUTONOMOUS),
IRINJALAKUDA
THRISSUR, KERALA-680 125

MARCH 2024

# A STUDY ON GRASSHOPPER DIVERSITY IN CHRIST COLLEGE IRINJALAKUDA

*Project report submitted to the University of Calicut in partial fulfillment of the requirement for the award of the Degree*

## BACHELOR OF SCIENCE
## IN ZOOLOGY

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**DEPARTMENT OF ZOOLOGY**
**CHRIST COLLEGE (AUTONOMOUS) IRINJALAKUDA**
**THRISSUR, KERALA 680125**

**Examiners:**

**1.** 　　　　　　　　　　**2.**

# DECLARATION

We, Akshay K A, Aleena Mariya, Anagha Arun M A, Anagha Saibu, Anjima Jose, Mariya T J, Neethu N M, Rahma and Sandra K Shaju, do hear by declare that this project entitled "**Study on grasshopper diversity in Christ College (Autonomous), Irinjalakuda**" is a genuine record of project work done by us under the guidance of Dr. Bijoy C., Assistant Professor, Department of Zoology, Christ College (Autonomous), Irinjalakuda, and has not been submitted to any university or Institution for the Award of any Degree or Diploma.

We further declare that results presented in this work and considerations made therein, contribute in general to the advancement of knowledge in science.

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## CERTIFICATE

This is to certify that the content of this project work entitled "**STUDY ON GRASSHOPPER DIVERSITY IN CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA**" is an original work done by the following students under my supervision and guidance at the Department of Zoology, Christ College (Autonomous), Irinjalakuda. I further certify that no part of the work has been presented for the award of any other Degree or Diploma.

| Sl. No | Register Number | Group members |
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**Place:** Irinjalakuda

**Date:**

**Dr. Bijoy C.**

Project Supervisor

## CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA

## DEPARTMENT OF ZOOLOGY

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Place: Irinjalakuda

Date:

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Head, Department of Zoology,

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# A Bioinformatic Study on the Molecular Evolution of Collagenases in Primates

*A project report submitted to the* ***University of Calicut*** *in partial fulfilment of the requirement for the award of the Degree*

## BACHELOR OF SCIENCE IN ZOOLOGY

BY



| Sl. No. | Name of students in the group | Register No. |
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DEPARTMENT OF ZOOLOGY

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**MARCH 2024**

# CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA
# DEPARTMENT OF ZOOLOGY

## CERTIFICATE

This is to certify that the project work entitled **'A Bioinformatic Study on the Molecular Evolution of Collagenases in Primates'** is an authentic record of research work carried out by **Chandana Janardhanan, Lakshmi AP, Niharika, Salvador VS, Abhinav Krishna PV, Aysha Nedha Sakir, Mithralmajan PT, Anjima NC** and **Grace Maria Paulson** as part of BSc syllabus during the year **2023-2024** and the results of this work has not been presented for the award of any other degree/ diploma in any university.

### Certified bona fide by

**Dr. Leyon Varghese**
Supervising Guide

**Dr Sudhikumar A. V.**
Head, Department of Zoology

Date :

Place :

### Examined by

1. ____________________________

2. ____________________________

# DECLARATION

We, the following students do hereby declare that this project report entitled **'A Bioinformatic Study on the Molecular Evolution of Collagenases in Primates'** is a genuine record of the project work done by us under the guidance of Dr. Leyon Varghese, Assistant Professor, Department of Zoology, Christ College (Autonomous), Irinjalakuda and that this report has not been submitted to any University/Institution for the award of any Degree or Diploma. We further declare that the results presented in this work and considerations made therein, contribute in general to the advancement of knowledge in science and is devoid of any plagiarism.

| Sl. No. | Name of Students | Register No. | Signature |
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Place : Irinjalakuda

Date : 28-02-2024

# CONTENTS

## INTRODUCTION

The first true primates evolved around 55 million years ago or a bit earlier, near the beginning of the Eocene Epoch. Their fossils have been found in North America, Europe, and Asia. They looked different from the present day primates. Changes in gene regulation and differences in mRNA expression levels across primates have often been documented, however, it is not yet known to what extent measurements of divergence in mRNA levels reflect divergence in protein expression levels, which are probably more important in determining phenotypic differences. Collagenases, a subgroup of Matrix matalloproteases (MMPs) are a large family of zinc-dependent endopeptidases with a great affinity for several components of the extracellular matrix. The collagenases include MMP-1 (interstitial collagenase/collagenase-1), MMP-8 (neutrophil collagenase/collagenase-2), and MMP-13 (collagenase-3). These MMPs attack triple helical regions of interstitial collagen types I, II, and III at a specific single site after the Gly residue of the partial sequences Gly-(Ile or Leu)-(Ala or Leu), located about three-fourths of the distance from the N-terminus. This cleavage generates fragments approximately three-fourths and one-fourth of the size of the collagen molecules. They are distinct from a closely related gelatinases (MMP2 and 9) that are characterized by the presence of the additional fibronectin domain located inside the catalytic domain.

A phylogenetic tree or evolutionary tree is a graphical representation which shows the evolutionary history between a set of species or taxa during a specific time. In other words, it is a branching diagram or a tree showing the evolutionary relationships among various biological species or other entities based upon similarities and differences in their physical or genetic characteristics. In evolutionary biology, all life on Earth is theoretically part of a single phylogenetic tree, indicating common ancestry. Phylogenetics is indeed the study of this phylogenetic tree. The main challenge is to find a phylogenetic tree representing optimal evolutionary ancestry between a set of species or taxa. The first step in the phylogenetic tree construction (using bioinformatics tool) with a new sequence would be to use BLAST. This nifty yet powerful resource matches your sequence to the millions of sequences stored in genomic and nucleotide databases. The tool comes up with the sequences most similar to the query submitted.

It also gives insights as to the possible identity of those sequences. The results include homologues across species and in similar tissues or organisms. A sequence alignment is a way of arranging the sequences of DNA, RNA, or protein to identify regions of similarity that may be a consequence of functional, structural, or evolutionary relationships between the sequences. If two sequences in an alignment, they share a common ancestor and mismatches can be interpreted as point mutations and gaps as indels (that is, insertion or deletion mutations) introduced in one or both lineages in the time since they diverged from one another. In sequence alignments of proteins, the degree of similarity between amino acids occupying a particular position in the sequence can be interpreted as a rough measure of how conserved a particular region or sequence motif is among lineages.

Phylogenetics and sequence alignment are closely related fields due to the shared necessity of evaluating sequence relatedness. The field of phylogenetics makes extensive use of sequence alignments in the construction and interpretation of phylogenetic trees, which are used to classify the evolutionary relationships between homologous genes represented in the genomes of divergent species. The degree to which sequences in a query set differ is qualitatively related to the sequences evolutionary distance from one another. Roughly,  high sequence identity suggests that the sequences in question have a comparatively young most recent common ancestor, while low identity suggests that the divergence is more ancient. This approximation, which reflects the “molecular clock” hypothesis that a roughly constant rate of evolutionary change can be used to extrapolate the elapsed time since two genes first diverged , assumes that the effects of mutation and selection are constant across sequence lineages.

## REVIEW OF LITERATURE

Primates are unique among placental mammals. Two extreme type of placentation are present in this single order. Strepsirrhines have non-invasive epitheliochorial placentation and Haplorhines have highly invasive haemochorial placentation. Strepsirrhines include Lemurs and Lorisiforms and Haplorhines include tarsiers and higher primates. Resemblance in placenta type provide the first evidence that tarsiers are linked to higher primates and distinct from lemurs and lorisiforms. Tree-shrews have endotheliochorial placentation and differ from both primate subgroups. Endotheliochorial placentation is primitive and epitheliochorial placentation is unlikely to be primitive.The recent availability of comprehensive molecular phylogenies for placental mammals has provided an independent framework to determine the most parsimonious interpretation of the evolution of placenta types (Robert Martin, 2008). In an earlier elaborate study, speciation between primates and rodents was estimated by looking at the protein coding genes of mitochondrial genomes from 31 mammals (A.D Yoder 2000). Based on paleontological data, three calibration points were used: one at 20–25 MYA for the hominoid/cercopithecoid divergence, one at 53–57 MYA for the cetacean/artiodactyl divergence, and the third at 110–130 MYA for the metatherian/eutherian divergence. Nulceotide and the amino acid sequence were looked at and results produced that were not mutually exclusive.

Even with decades of data and methods, we still can’t agree on the exact evolutionary tree of higher primates (apes and humans). The most likely scenario has humans closest to chimps, but other possibilities exist. Despite numerous theories, 20 key reasons cause this uncertainty. New methods using DNA offer hope for more definitive answers. (Holmquist et al 1988). Primate phylogeny forms a solid framework for a novel depiction of diverse patterns of genome evolution among primate lineages. They are essential for future comparative genomic investigation of adaptation and selection in humans and across primates. Studies on the evolution of catarrhine primates were done using molecular, fossil and bio geographical data. It was found that the common ancestor of Old World Monkeys originated in Africa and some monkeys later moved to Asia around 10 million years ago. The study further suggested that the ancestor of the

living hominids left Africa about 20 mya and the common ancestor of the living African apes returned to Africa from Eurasia around 10 mya (Caro-Beth Stewart, Todd R Disotell 1998).

In the deep study of evolutionary roots of strepsirrhine primate labyrinthine morphology, geometric morphometric analysis showed that the labyrinthine morphology of extant strepsirrhines contains a mixed locomotor, allometric and phylogenetic signal. Discriminant analysis at the family level confirmed that labyrinthine shape is a good taxonomic marker. The results support the hypothesis that evolutionary change in labyrinthine morphology is adequately described with a random walk model, i.e. random phenotypic dispersal in morphospace (Lebrun et al, 2010). An overview of the taxonomy of New World primates based on morphology to the great number of studies based on molecular data aiming for the elucidation of the phylogeny of New World monkeys. The traditional classification of the infraorder Platyrrhini divided these primates into Cebidae and the Callitrichidae, with Callimico being allocated to either the former (Simons, 1972, Simpson, 1945) or the latter family. Hill (1957) and Hershkovitz, 1972, Hershkovitz, 1977 proposed a third family – Callimiconidae – to accommodate Callimico, because it shares characteristics that define both cebids and callitrichids. According to Hershkovitz (1977), then all New World primates should be included in one of three families – the Callitrichidae which comprised the marmosets, tamarins (Saguinus) and lion tamarins (Leontopithecus), the monotypic Callimiconidae (Callimico) and the Cebidae (Schneider et al, 2015).

In a study on molecular phylogeny and evolution of primate mitochondrial DNA, researchers determined nucleotide sequences of homologous 0.9-kb fragments of mitochondrial DNAs (mtDNAs) derived from four species of old-world monkeys, one species of new-world monkeys, and two species of prosimians. With these nucleotide sequences and homologous sequences for five species of hominoids, they constructed a phylogenetic tree for the four groups of primates. The phylogeny obtained is generally consistent with evolutionary trees constructed in previous studies. The results also suggest that the rate of nucleotide substitution for mtDNAs in hominines (human, chimpanzee, and gorilla) have slowed down compared with that for old-world monkeys (Hayasaka, 1988). Mitochondrial genomes have been used to study the

phylogenetic relationship of primates in detail. Using 454 sequencing, the study adds 32 new complete mitochondrial genomes and introduces 20 previously unrepresented genera in the primate tree. The study focuses on the New world monkeys and suborder Strepsirrhini. (Knut Finstermeier, et al 2013). The evolutionary relationships of the number of species within the genus Lepilemur were analysed with the help of a comparative cytogenetic and molecular study. The study involved the complete sequencing of the mitochondrial cytochrome b gene from 68 individuals and the results were compared to those obtained from cytogenetic studies derived from 99 specimens. The results support the classification of the eight major supportive lemur taxa as independent species. (Nicole Andriaholinirina, et al. 2006)

The relationship between the prion protiens and new world primate phylogeny have been studied. The PrP C prion protein contains 250 amino acids with some variation among species and is expressed in several cell types. Variations in the prion protein gene were observed among 16 genera of New World primates (Platyrrhini), and resulted in amino acid substitutions when compared with the human sequence. Schneider et al, 2004)

Beta-globin gene cluster of primates were analyzed to understand their evolutionary history. The rate of accumulation of mutations have also been seen to vary by a factor of 7 among different primate lineages. The study groups superfamilies Lemuroidea and Lorisoidea into suborder Strepsirhini and Tarsius and Anthropoidea into suborder Haplorhini. Evolution rates have been suggested to have slowed down over the past 25 million years of hominoid descent and has found to have happened in correlation with lengthened lifespans (Koop, BF et al 1989).

Using the SINE's methods for the analysis of mobile element based of old world monkeys. It helps to known ancestral staples. Makes them to useful genetic studies for phylogenetic studies. Alu is an helping part of it, in this methods found 285 new Alu Insertions from sixteen old world monkeys. Old world monkeys are represent on the most diverse and largest primate families. And have respect classification. The phylogenetic researchers are classified and grouped the old world monkeys into different classes and divisions. Mainly the subfamily cerocopithecidae are the most studied group.. SINEs ( short interspersed element are

used  as the genetic markers this  will helps to analysis several levels of phylogenetic analysis. Using both Compcompuational and PCR methods (Xing a et al, 2005).

New world monkeys represent monophyletic group. The phylogenetic relationships among new world monkeys have been extensively investigated using nucleotide sequence from different genome.In these studies still there are some unresolved issues.There are three monophyletic new world monkey families Atelidae, Cebidae and Pitheciidae. As a result Maximum parsimony analysis support the three proposed platyrrhine families. In the maximum parsimony tree, the two most closely related families are Atelidae and Cebidae.Phylogenetic relationships were reconstructed by maximum parsimony, maximum likelihood, and Bayesian approaches (JuanC Opazo et al, 2006). Anthropoid primates from the neotropics are members of parvorder Platyrrhini. The platyrrhines are also called New World monkeys. There are more than 125 species of extant New World monkeys  found in approximately 15 genera. The phylogenetic relationships of these neotropical primates have been extensively studied from a molecular perspective (Derek wildman et al, 2009).

Phylogenetic trees are certainly useful for comparative studies, providing a useful framework for comparative biologists. Species evolution is not statistically independent. The fact that close relatives inherit characteristics from their common ancestor has always complicated the analysis of cross- species data. The methods in turn developed to resolve such issues, all requires resolved phylogeny. In one of the earlier studies, primates phylogeny was estimated of all 203 species of primates. Application of parsimony algorithm and bootstrapping resulted in the composite tree with 160 nodes (Purvis, Andy 1995).

In a project conducted under the support from National Cancer Institute and National Institute of Health, researchers constructed a robust phylogenetic tree of primates. The tree was constructed from the data collected of genomic sequences from 186 primates. Also outgroup species from Dermoptera, Scandentia and Lagomorpha was included. This phylogenetic representation done carefully was a notable illumination showing the pathway of primates evolution (Perelman et.al 2011).

Studies also estimated the molecular divergence dates of major primates in the context of molecular clock studies. Such studies also aid in understanding the lineage. Utilizing the genomic data, molecular divergence dates were able to be studied since alignments can be arranged and sites can be analysed for this study. Much before the molecular clock, paleontology used to provide only a mere timeframe of species evolution (Steiper et.al. 2006).

Inferring molecular phylogeny for evolutionary studies are done in non- primates as well. The molecular phylogeny of malarial parasites was recovered from mitochondrial cytochrome b gene sequences. Parsimony as well as maximum- likelihood analysis produced similar phylogenetic trees in this case. The conclusions were supported by hypothesis testing (Perkins et.al 2002). Inferring species super matrix has helped in studying macroevolutionary dynamics and even historical biogeography. The results obtained highlighted both the power as well as limitations of inferring the molecular phylogeny data to different species concepts (Springer et.al. 2012).

Over the past 60 million years, a million copies of Alu DNA have appeared in the genomes of primates. This is still an ongoing process. DNA alu repeats in the genomes of primates such as human, chimpanzee, gorilla, orangutan, baboon, rhesus, and macaque. New Alu elements arise in unique and irreversible events and appear to prevent precise excision and loss. The same insertions cannot occur independently in two species. Once the insert is genetically fixed, the DNA elements persist in all descendant lineages. Different from point mutation, the distribution of individual alu corresponds to a phylogeny only (H. Hamdi, 1999).

To resolve the debate in strepsirrhine phylogeny, 61 loci containing interspersed elements were characterized and the absence and presence of orthologous loci in the strepsirrhine panel was determined. According to these findings, it is concluded that strepsirrhines originated in Africa, and that Madagascar and Asia were colonized by immigration events (C. Roos, 2004). To investigate the phylogenetic relationships among species of New World monkeys, 1.3 kb of DNA was collected for 2 introns of the glucose-6-phosphate dehydrogenase locus encoded on the x chromosome of 24 species of New World monkeys (M. Von. Dornum, 1999).

Two molecular based approaches are used to date the initial divergence of the platyrrhine clade, a relaxed clock model using fossil record and genome datasets, and Bayesian inferences from generation time and body size to substitution rate. Fossil constraints, topology, and substitution rate are an important part of our divergence time estimates.  making an impact. Bayesian estimates using conservative and realistic fossil constraints suggest that the LCA of extant platyrrhines is 29 Ma, with a 95% confidence interval for Nodine of 27–31 Ma (SI Perez, 2013). The sequences of nuclear protein-coding gene LCAT were used to study the relationship between 19 extant rodents. The study agrees with several previous molecular and morphological studies, both concerning branching orders inside Muroidea and the bush-like radiation of rodent suprafamilial taxa. This indicates that this nuclear gene is a fitting candidate for tackling questions about rodents relationships.

The data from primates were used to reveal that the molecular clock in CpG and non-CpG sites have different nature, projecting differences in their molecular origin. Through the process, it was observed that molecular clocks are heterogeneous even within a genome. During phylogenetic analysis and while concluding divergence times using molecular data, one should be mindful that different regions of genome follow different  molecular clocks. In this study, our efforts are directed towards studying the pathway of certain collagenases in the course of evolution. Even though  some studies have been done using DNA sequences and that too in different context, in our study we focusses primarily on amino acid sequences. This is not a well researched area. Though this study we aim on providing a new work in the area of comparative biology. The results of the work may be useful in the future providing insights into how may be the few crucial changes in amino acids may have resulted into a complete new lineage.

## SIGNIFICANCE OF THE STUDY

The study of molecular evolution in primates through the comparison of amino acid sequences using bioinformatics tools represents a novel and underexplored area of research. To date, there has been a notable scarcity of studies employing bioinformatics techniques to investigate the evolutionary patterns of primates, particularly in relation to proteins such as MMP1, MMP8 and MMP13 collagenases. The selection of these collagenases for our study is particularly significant due to their split genes nature. By conducting a comparative analysis of the evolutionary trees derived from the collagenases with established standard trees, we aimed to shed light on the distinctive evolutionary trajectories of these proteins in primates. The insights obtained from this comparative study have the potential to deepen our understanding of the molecular evolution of primates and elucidate the factors driving the evolution of collagenases in this taxonomic group.

**OBJECTIVES**

1. Retrieval of relevant data (Gene/mRNA/protein sequence of collagenases of primates) from relevant reliable resources such as NIH or SIB.
2. Align the retrieved sequences using bioinformatics software to ensure they are in the correct reading frame and homologous positions are appropriately aligned.
3. Construction of the phylogenetic trees based on the Gene/mRNA/protein sequence of collagenases in primates.

## METHODOLOGY

The three human collagenases used in the study are MMP1, MMP8 and MMP13. The FASTA sequence and other details of collagenases are as below.

```
>NP_002412.1 interstitial collagenase isoform 1 MMP1 UniProt_P03956 [Homo sapiens]
MHSFPPLLLLLFWGVVSHSFPATLETQEQDVDLVQKYLEKYYNLKNDGRQVEKRRNSGPVVEKLKQMQEF
FGLKVTGKPDAETLKVMKQPRCGVPDVAQFVLTEGNPRWEQTHLTYRIENYTPDLPRADVDHAIEKAFQL
WSNVTPLTFTKVSEGQADIMISFVRGDHRDNSPFDGPGGNLAHAFQPGPGIGGDAHFDEDERWTNNFREY
NLHRVAAHELGHSLGLSHSTDIGALMYPSYTFSGDVQLAQDDIDGIQAIYGRSQNPVQPIGPQTPKACDS
KLTFDAITTIRGEVMFFKDRFYMRTNPFYPEVELNFISVFWPQLPNGLEAAYEFADRDEVRFFKGNKYWA
VQGQNVLHGYPKDIYSSFGFPRTVKHIDAALSEENTGKTYFFVANKYWRYDEYKRSMDPGYPKMIAHDFP
GIGHKVDAVFMKDGFFYFFHGTRQYKFDPKTKRILTLQKANSWFNCRKN

>NP_002415.1 neutrophil collagenase isoform 1 MMP8 UniProt_P22894 [Homo sapiens]
MFSLKTLPFLLLLHVQISKAFPVSSKEKNTKTVQDYLEKFYQLPSNQYQSTRKNGTNVIVEKLKEMQRFF
GLNVTGKPNEETLDMMKKPRCGVPDSGGFMLTPGNPKWERTNLTYRIRNYTPQLSEAEVERAIKDAFELW
SVASPLIFTRISQGEADINIAFYQRDHGDNSPFDGPNGILAHAFQPGQGIGGDAHFDAEETWTNTSANYN
LFLVAAHEFGHSLGLAHSSDPGALMYPNYAFRETSNYSLPQDDIDGIQAIYGLSSNPIQPTGPSTPKPCD
PSLTFDAITTLRGEILFFKDRYFWRRHPQLQRVEMNFISLFWPSLPTGIQAAYEDFDRDLIFLFKGNQYW
ALSGYDILQGYPKDISNYGFPSSVQAIDAAVFYRSKTYFFVNDQFWRYDNQRQFMEPGYPKSISGAFPGI
ESKVDAVFQQEHFFHVFSGPRYYAFDLIAQRVTRVARGNKWLNCRYG

>NP_002418.1 collagenase 3 MMP13 UniProt_P45452 [Homo sapiens]
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The study on phylogenetic relationships in primates was conducted using this amino acid sequences to do the BLAST (Basic Local Alignment Search Tool) analysis in the NCBI Genebank database. The most suitable amino acid sequences for each primate species were then carefully selected from sequences delivered by the server. An out group was chosen which in our study was the Mus musculus of the order Rodentia.

The selected sequences were then compared with that of the out group and a phylogenetic tree was constructed based on the degree of divergence. The software used for constructing phylogenetic tree was  Molecular Evolutionary Genetics Analysis (MEGA).

## RESULTS AND DISCUSSIONS

The research article titled "A Molecular Phylogeny of Living Primates" published in 2011, established a robust and widely accepted framework for understanding primate evolution. This phylogenetic tree served as a standard reference for our study, allowing us to compare our data and draw conclusions. According to this article Order Primata is subdivided into two major Suborder Haplorrhini and Strepsirrhini. The remaining primate phylogeny is classified as follows.

**Suborder Haplorrhini** further divides into Infraorders, namely Simiiformes and Tarsiiformes. Tarsiiforme include only one Family (Tarsiidae) with only two extant species. Simiiformes is subdivided into Parvorders Catarrhini (Old world) and Platyrrhini (New world).

Parvorder Catarrhini in turn consist of the Superfamilies Cercopithecoidea and Hominoidea. Cercopithecoidea has only one extant Family *viz*. Cercopithecidae but the organisms of Superfamily Hominoidea is further divided into two Families, *viz*, Hylobatidae and Hominidae. Family Cercopithecidae has two Subfamilies such as Cercopithecinae and Colobinae. Family Hylobatidae include all Gibbon Genus and there is no further subgrouping. Hominidae on the other hand has two Subfamilies *viz.* Homininae and Ponginae. Subfamily Ponginae include all species of Orangutang and all o there Greater Apes and Humans are included in Homininae. Subfamily Cercopithecinae is subdivided into two Tribes namely, Papionini and Cercopithecini whereas Colobinae is subdivided into two Tribes namely Presbytini and Colobini.

Parvorders Platyrrhini on the other hand is divided directly into three Families such as Cebidae, Atelidae and Pitheciidae. Family Cebidae has four Subfamilies namely, Callitrichinae, Aotinae, Cebinae and Saimirinae. Fly. Atelidae has two Subfamilies (Atelinae & Alouattinae) so also Fly. Pitheciidae (Callicebinae & Pitheciinae).

**Suborder Strepsirrhini** is divided into the Infraorders Lemuriformes, Chiromyiformes and Lorisiformes. Unlike Haplorrhini, there is no observed grouping of these Infraorders into Parvorders or Superfamilies. Instead, they are grouped into Families such as Lepilemuride,

Cheirogaleidae, Indriidae, Lemuridae, Daubentoniidae, Lorisidae and Galagidae. Further subdivision within Lorisidae includes the subfamilies Lorisinae and Perodicticinae.

**MMP-1**

The phylogenetic tree for the MMP1 gene in primates was meticulously constructed, employing an analysis of amino acid sequences from various primate species. To enhance our phylogenetic analysis, *Mus musculus* was strategically employed as the outgroup, providing a reference point for the evolutionary relationships within the MMP1 collagenase gene among primates. Our investigation also utilized a well established standard phylogenetic tree for primates, derived from genomic sequences across diverse species, serving as a foundational reference for elucidating the evolutionary dynamics of collagenase genes within our study group (Reference). The results obtained regarding the evolutionary pathway of the MMP1 gene include the following observations:

- *Carlito syrichta*: Our findings indicate that MMP1 gene of *Carlito syrichta,* a tarsier species primarily descended with minimal changes from the common ancestor of all primates indicating an ancient ancestry. Although this tree suggests such an ancient ancestry and early divergence of *Carlito syrichta* from the early primate stock, a comparison with the established tree reveals that tarsiers diverged from a common stock of strepsirrhini - more primitive primate. It is therefore inferred that the MMP1 gene remained with minimum changes in the tarsiers as compared to strepsirrhini primates.

- *Hominidae:* In our tree constructed using MMP1 the common ancestor of *Pan* and *Homo*, along with the common ancestor of *Gorilla* and *Pongo,* collectively share a common ancestor. Gibbons, including *Nomascus* and *Symphalangus,* share a common ancestor that along with the common ancestor of *Hominidae* were descended from a common stock of interbreeding ape like animal. Upon analysing the standard phylogenetic tree, a similar pattern emerges, with *Homo* and *Pan* sharing a common ancestor. This common ancestor was also ancestral to present day *Gorilla,* from which the *Pongo* ancestry might have diverged. However, the discrepancy in our results suggestive of *Gorilla* sharing a recent

common ancestor with *Pongo,* but not with *Homo* or *Pan*. This suggests a simultaneous origin for *Gorilla* and *Pongo*, contrary to the standard tree's assertion of *Gorilla*'s more recent evolution compared to *Pongo*. Further analysis of the amino acid sequences are required to see if the *Homo-Pan* group has any common advantage with the kind of changes on the MMP1 protein over the *Gorilla-Pongo* group.

- Old World Monkeys: Our results indicate that, three groups *viz. Macaca*, *Papio* and *Theropithecus* are equally distant from a common ancestor, while *Colobus* and *Trachypithecus* share another common ancestor. The standard phylogenetic tree confirms this, revealing a common ancestor for *Colobus* and *Trachypithecus,* along with the ancestor of *Macaca, Papio* and *Theropithecus.* But with *Macaca, Papio* and *Theropithecus,* our results differ from the standard tree. While standard tree implies that *Papio* and *Theropithecus* had a common ancestor after the common ancestry shared with *Macaca,* our tree do not mention between an ancestor common to both *Papio* and *Theropithecus.* Though the changes are minimal, it wold be interesting to look for the their sequences for further analysis.

- New World Monkeys: Our findings in New World Monkeys suggest that *Saimiri* and *Cebus* share a most recent common ancestor, while *Aotus* share a common ancestor with this lineage. This is consistent with both our phylogenetic tree and the standards phylogenetic tree. Furthermore, *Nycticebus* and *Otolemur* share a common ancestor, and *Lemur* and *Microcebus* also share a common ancestor. The common ancestors of these pairs collectively had a single common ancestor, aligning with observations on the standard phylogenetic tree.

**MMP-8**

- *Hominidae*: In the phylogenetic tree derived from MMP8 sequence data, it was observed that the common ancestor of Homo and Gorilla shares ancestry with the common ancestor of Pan. This collective ancestry is further linked to the common ancestor of Hominidae, which is shared with Gibbons. In contrast to the standard phylogenetic tree, where Pan and Homo share an ancestor ancestral to present-day Gorilla, our results suggest the potential existence of an alternative evolutionary pathway for these three species. A comprehensive investigation is recommended to explore the implications of this alternative pathway further.

- Loris: Our findings indicate that the Loris shares a common ancestor with Hominidae, Tarsier, Gibbons, New World, and Old World monkeys, all of which originate from the Strepsirrhini primates. Similarly, Lemurs are shown to arise from Haplorrhini primates. Discrepancies with the standard phylogenetic tree, which suggests a more recent common ancestry for Lemurs and Loris, necessitate further analysis to validate the proposed ancestral pattern among the descendants of these two major groups of early primates.

- New World Monkeys: Upon examining the lineage of New World monkeys, it is observed that recent descendants Aotus and Saimiri share a common ancestor, which is further linked to the common ancestor of Cebus and Sapajus. This lineage can be traced back to early Strepsirrhini primates. Although minor differences are noted compared to the standard phylogenetic tree, where an ancestor common to Saimiri and Cebus precedes the common ancestry with Aotus, further analysis is warranted to explore these nuances.

- Old World Monkeys: Our analysis reveals that Papio and Theropithecus share a common ancestor, which is connected to the common ancestor of Macaca. This ancestral lineage can be traced back to an ancestor shared with the common ancestor of Piliocolobus and Trachypithecus. The observed pattern aligns with the standard phylogenetic tree in the lineage of Old World monkeys.

**MMP-13**

- *Hominidae*: When we comparing the phylogenetic tree made by us on the basis of MMP13 and the standard one, the Nomascus leucogenys & Symphalongus syndactylus (Hylobatidae) share a recent common ancestor and they together share common ancestor with old world monkeys in MMP13. But, when we comparing this with the standard one we can observe that the Hylobatidae sharing common ancestor with Hominidae.

- New World Monkeys: Our findings in new world monkeys by comparing the Standard phylogenetic tree with the phylogenetic tree of MMP13 depicting that, in the phylogenetic tree of MMP13, the Cebus imitator & Sapajus apella shares a recent common ancestor and these group share a common ancestor with Samiri bolivensis and all of these collectively share a common ancestor with Aotus nancymaae. When we comparing this with the standard phylogenetic tree Cebus imitator & Samiri bolivensis directly arrived from a common ancestor.

- Old World Monkeys: By analysing the group Cercopithecidae in the tree of MMP13, Papio Anubis & Theropithecis gelada share a recent common ancestor and they together share a common ancestor with Macaca group, Piliocolobus tephrosceles & Trachypithecus francoisi directly. But when we comparing this with the standard phylogenetic tree, they where not sharing a common ancestor directly, all of them share a common ancestor with other species recently, but all of them primitively share a common ancestor.

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Alignment: D:\Leyon\Evolution\MMP1\1-tree_for_seaview.txt
Seaview [blocks=10 fontsize=12 A4-landscape] on Wed Jan 31 07:26:41 2024

                             1
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Mus_musculus                 MPSLP---LL LLLWAASSYS FPVFHNGDRQ NVETVWKYLE NYYNL---GK NMQAKNVNGK EMMAEKLRQM
Aotus_nancymaae              MHSYPP-LLL LLFWGVVSHG FPATLETQEQ DVEIVQKYLE QYYNLKNDGK QVEKKRSSGP --VVEKLKQM
Carlito_syrichta             MPSLP--LVL MLLWAVGSRG FPATSETREQ DVEIVQKYLE NYFNLKNDGK QFEKQRHSAP --VVEKLKEM
Cebus_imitator               MHSYPL-LLL LLFWGVVSHG FPATLETQEQ DVEIVQKYLE QYYNLKNDGK QVEKQRNSGP --VVEKLKQM
Gorilla_gorilla              MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Lemur_catta                  MPSFS--LLL LLLWGLGSHG FPAIPETQEQ DVEIVQKYLE NYYDLKNVGK QIEKKRSSGS --VVEKLKQM
Macaca_mulatta               MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDFVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Macaca_nemestrina            MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Microcebus_murinus           MPRFS--LLL LLLWSLGSHG LPVAPETQEQ DVEIVQKYLE NYYDLKNDGK QIEKKRNSGP --VVEKLKQM
Nomascus_leucogenys          MHSFPPLLLL LLFWSVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGL --VVEKLKQM
Nycticebus_coucang           MPSF---LLL LLLWGLGSHA FPAIPEPQEQ DVEIVQKYLE NYYDLKNDGS QIERKRNSGP --VVEKLKQM
Otolemur_garnettii           MSSFP--LLL LLLWGLGSHA LPVTPETQEQ DVEIVQKYLE NYYDLKNDGM QIERKRNSGP --VVEKLKQM
Pan_paniscus                 MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Pan_troglodytes              MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Papio_anubis                 MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Piliocolobus_tephrosceles    MHSFPPLLLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVQKQRNSGP --VVEKLKQM
Pongo_abelii                 MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Pongo_pygmaeus               MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Saimiri_boliviensis          MHSYPP-LLL LLFWSVVSHG FPATLETQEQ DVEIVQKYLE QYYDLKNDGK QVEKQRNSGP --VVEKLKQM
Sapajus_apella               MHSYPL-LLL LLFWGVVSHG FPATLETQEQ DVEIVQKYLE QYYNLKNDGK QVEKQRNSGP --VVEKLKQM
Symphalangus_syndactylus     MHSFPPLLLL LLFWSVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGL --VVEKLKQM
Theropithecus_gelada         MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Trachypithecus_francoisi     MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDRR QVEKQRNSGP --VVEKLKQM
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71

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|---|---|---|---|---|---|---|---|
| Homo_sapiens | QEFFGLKVTG | KPDAETLKVM | KQPRCGVPDV | AQFVLTEGNP | RWEQTHLTYR | IENYTPDLPR | ADVDHAIEKA |
| Mus_musculus | QQLFGLKVTG | NSDPETLRAM | KKPRCGVPDV | APYAITHNNP | RWTKTHLTYS | ILNYTPYLPK | AVVEDAIARA |
| Aotus_nancymaae | QEFFGLKVTG | KPDAETLNVM | KQPRCGVPDV | ARFVLTEGNP | RWEKTHLTYR | IENYTPDLPR | ADVDQAIEKA |
| Carlito_syrichta | QKFFGLKVTG | KPDPETLKVM | KQPRCGVPDV | AQFVLTEGNP | RWQKTDLTYR | IENYTPDLPK | AEVDRAIEKA |
| Cebus_imitator | QEFFGLKVTG | KPDAETLKVM | KQPRCGVPDV | ARFVLTEGNP | RWKKTHLTYR | IENYTPDLPR | SDVDHAIEKA |
| Gorilla_gorilla | QEFFGLKVTG | KPDAETLKVM | KQPRCGVPDV | AQFVLTEGNP | RWEQTHLTYR | IENYTPDLPR | ADVDHAIEKA |
| Lemur_catta | QEFFGLKVTG | KPDTETLKVM | KQPRCGVPDV | ARFVLTQGNP | RWEQTHLTYR | IENYTPDLPR | ADVDLAIEKA |
| Macaca_mulatta | QEFFGLKVTG | KPDAETLKVM | KQPRCGVPDV | AQFVLTEGNP | RWEQTHLTYR | IENYTPDLPR | AAVDQAIEKA |
| Macaca_nemestrina | QEFFGLKVTG | KPDAETLKVM | KQPRCGVPDV | AQFVLTEGNP | RWEQTHLTYR | IENYTPDLPR | AAVDQAIEKG |
| Microcebus_murinus | QEFFGLKVTG | KPDTETLKVM | KQPRCGVPDV | ARFVLTQGNP | RWEKTHLTYR | IENYTPDLSR | ADVDHAIEKA |
| Nomascus_leucogenys | QEFFGLKVTG | KPDAETLKVM | KQPRCGVPDV | AQFVLTAGNP | RWEQTHLTYR | IENYTPDLPR | ADVDHAIEKA |
| Nycticebus_coucang | QEFFGLKVTG | TPDTETLKVM | KQPRCGVPDV | ARFALTPGNP | RWEQTHLTYR | IENYTPDLPR | ADVDDAIEKA |
| Otolemur_garnettii | QEFFGLKVTG | TPDTETLKVM | KQPRCGVPDV | ARFVLTQGNP | RWEQTHLTYR | IENYTPDLPK | ADVDDAIEKA |
| Pan_paniscus | QEFFGLKVTG | KPDAETLKVM | KQPRCGVPDV | AQFVLTEGNP | RWEQTHLTYR | IENYTPDLPR | ADVDHAIAKA |
| Pan_troglodytes | QEFFGLKVTG | KPDAETLKVM | KQPRCGVPDV | AQFVLTEGNP | RWEQTHLTYR | IENYTPDLPR | ADVDHAIAKA |
| Papio_anubis | QEFFGLKVTG | KPDAETLKVM | KQPRCGVPDV | AQFVLTEGNP | RWEQTHLTYR | IENYTPDLPR | AAVDQAIEKA |
| Piliocolobus_tephrosceles | QEFFGLKVTG | KPDAETLKVM | KQPRCGVPDV | AQFVLTEGNP | RWEQTHLTYR | IENYTPDLPR | ADVDRAIEKA |
| Pongo_abelii | QEFFGLKVTG | KPDAETLKVM | KQPRCGVPDV | AQFVLTEGNP | RWEQTHLTYR | IENYTPDLPR | ADVDHAIEKA |
| Pongo_pygmaeus | QEFFGLKVTG | KPDAETLKVM | KQPRCGVPDV | AQFVLTEGNP | RWEQTHLTYR | IENYTPDLPR | ADVDHAIEKA |
| Saimiri_boliviensis | QEFFGLKVTG | KPDAETLNVM | KQARCGVPDV | ARFVLTEGNP | RWEKTHLTYR | IENYTPDLRR | ADVDHAIEKA |
| Sapajus_apella | QEFFGLKVTG | KPDAETLKVM | KQPRCGVPDV | ARFVLTEGNP | RWEKTHLTYR | IENYTPDLPR | SDVDHAIEKA |
| Symphalangus_syndactylus | QEFFGLKVTG | KPDAETLKVM | KQPRCGVPDV | AQFVLTAGNP | RWEQTHLTYR | IENYTPDLPR | ADVDHAIEKA |
| Theropithecus_gelada | QEFFGLKVTG | KPDAETLKVM | KQPRCGVPDV | AQFVLTEGNP | RWEQTHLTYR | IENYTPDLPR | AAVDQAIEKA |
| Trachypithecus_francoisi | QEFFGLKVTG | KPDAETLKVM | KQPRCGVPDV | AQFVLTEGNP | RWEQTHLTYR | IENYTPDLPR | ADVDRAIEKA |

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Mus_musculus                 FRVWSDVTPL TFQRVFEEEG DIVLSFHRGD HGDNNPFDGP NYKLAHTFQP GPGLGGDVHY DLDETWTNSS
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Carlito_syrichta             FQLWSNASPL RFTKVVEGQA DIMISFVRGD HQDNSPFYGP GENLAHAFQP GPNIGGDAHF DEDETWTNNI
Cebus_imitator               FQLWSNVTPL TFTKVPKGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GSGIGGDAHF DEDETWTNNF
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Otolemur_garnettii           FQLWSNASPL TFTKVFQGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDEKWTNNL
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Pan_troglodytes              FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Papio_anubis                 FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Piliocolobus_tephrosceles    FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Pongo_abelii                 FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
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Saimiri_boliviensis          FQLWSNVTPL TFTKVPKGQA DIMISFVRGD HQDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDETWTNNF
Sapajus_apella               FQLWSNVTPL TFTKVPKGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDETWTNNF
Symphalangus_syndactylus     FKLWSDVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DDDERWTNNF
Theropithecus_gelada         FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Trachypithecus_francoisi     FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
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Mus_musculus                ENFNLFYVTA HELGHSLGLT HSSDIGALMF PSYTWYTEDF VLNQDDINRI QDLYGPSPNP IQPTGATTPH
Aotus_nancymaae             REYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGKSQNP VQPTGPQTPQ
Carlito_syrichta            QNYNLYRVAA HEFGHSLGLS HSTDIGALMY PTYT-YSGDV QLAQDDIDGI QAIYGPSQNP IQPTGPQTPQ
Cebus_imitator              RGYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGQSPNP VQPTGPQTPQ
Gorilla_gorilla             REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Lemur_catta                 RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYT-FSGDV QLAQDDIDGI QAIYGPSQNP NQPTGPQTPQ
Macaca_mulatta              REYNLYRVAA HEFGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Macaca_nemestrina           REYNLYRVAA HELGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Microcebus_murinus          RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYA-FSGDV QLAQDDIDGI QAIYGPSQNP NQPIGPQTPQ
Nomascus_leucogenys         REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Nycticebus_coucang          RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYA-FSGEV ELAQDDIDGI QAIYGPSQNP IQPIGPQTPQ
Otolemur_garnettii          RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYA-FSGEV ELAQDDIDGI QAIYGPSQNP VQPTGPQTPQ
Pan_paniscus                REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGHSQNP VQPIGPQTPK
Pan_troglodytes             REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Papio_anubis                REYNLYRVAA HELGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Piliocolobus_tephrosceles   REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLSQDDIDGI QAIYGGSQNP VQPTGPQTPK
Pongo_abelii                REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGPSQNP VQPIGPQTPK
Pongo_pygmaeus              REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGPSQNP VQPIGPQTPK
Saimiri_boliviensis         REYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGPSPNP VQPTGPQTPQ
Sapajus_apella              REYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGQSPNP VQPTGPQTPQ
Symphalangus_syndactylus    REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Theropithecus_gelada        REYNLYRVAA HELGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Trachypithecus_francoisi    REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
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                             281
Homo_sapiens                 ACDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Mus_musculus                 PCNGDLTFDA ITTFRGEVFF FKGRFYIRVN RFMPEPELNL IGILWPNLPV KLDAAYEASM IDQVRYFKGS
Aotus_nancymaae              VCDSKLTFDA ITTIRGEVFF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Carlito_syrichta             ACDSKISFDA VTTIRGEVMF FKDRFFMRTH PSYPEADLNF ISDFWPLLPN GLEAAYEDAG RDQVRFFKGY
Cebus_imitator               VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PYYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Gorilla_gorilla              VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLQAAYEFAD RDEVRFFKGN
Lemur_catta                  VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPS GLEAAYEVAS RDEVRFFKGN
Macaca_mulatta               VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Macaca_nemestrina            VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Microcebus_murinus           VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF VSVFWPQLPT GLEAAYEVAD RDEVRFFKGN
Nomascus_leucogenys          VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Nycticebus_coucang           VCDSKLTFDA VTTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPS GLEAAYEVVD RDEIRFFKGN
Otolemur_garnettii           VCDSKLTFDA VTTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEVAD RDEVRFFKGN
Pan_paniscus                 VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PSYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Pan_troglodytes              VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Papio_anubis                 VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Piliocolobus_tephrosceles    VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLQAAYEFAE RDEVRFFKGN
Pongo_abelii                 VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Pongo_pygmaeus               VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Saimiri_boliviensis          VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Sapajus_apella               VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PYYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Symphalangus_syndactylus     VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGK
Theropithecus_gelada         VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Trachypithecus_francoisi     VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLQAAYEFAD RDEVRFFKGN
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                            351
Homo_sapiens                KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Mus_musculus                KVWAVQEQSV LRGFPRDIHS FFGFPSNVTH IDAAVCEEET GKTYFFVDHM YWRYDENTQS MDPGYPRLTA
Aotus_nancymaae             KYWAAQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDAGYPKMIA
Carlito_syrichta            RFWAVQGQDV LRGYPQDIYS SYGFPRTVKH IDAAVFEEET GKTFFFVGNK YWRYDEYKRS MDVGYPKMIA
Cebus_imitator              KYWAVQGQNV LYGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDAGYPKKIA
Gorilla_gorilla             KYWAVQGQNM LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDPGYPKMIA
Lemur_catta                 KYWAVQGQNV LPGYPKDIYR SFGFPRTVKH IDAAISEEDT GKTYFFVANK YWRYDEYKQS MDTGYPKKLA
Macaca_mulatta              KYWAVQGQNV LPGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Macaca_nemestrina           KYWAVQGQNV LPGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Microcebus_murinus          KYWAVQGQNV LPGYPKDIYK SFGFPKTVKH IDAAVSEEDT GKTYFFVANK YWRYDEYKQS MDAGYPKMIA
Nomascus_leucogenys         KYWAVQGQNV LHGYPKDIYS SFGFPRTVKR INAALSEENT GKTYFFVAKK YWRYDEYKRS MDPGYPKMIA
Nycticebus_coucang          KYWAVRGQDV LHGYPKDISS SFGFPRTVKH VDAAVSEEET GKTYFFVANK YWRYDENKQS MDTGYPKMIA
Otolemur_garnettii          KYWAVRGPDV LHGYPKDISS SFGFPRTVKH VDAAVSEEET GKTYFFVANK YWRYDENKQS MDTGYPKTIA
Pan_paniscus                KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Pan_troglodytes             KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Papio_anubis                KYWAVQGQNV LPGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIS
Piliocolobus_tephrosceles   KYWAVQGQNV LRGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Pongo_abelii                KYWAVQGQNM LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEHKRS MDPGYPKMIA
Pongo_pygmaeus              KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Saimiri_boliviensis         KYWAVQGQNV LYGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDAGYPKMIA
Sapajus_apella              KYWAVQGQNV LYGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDAGYPKKIA
Symphalangus_syndactylus    KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVAKK YWRYDEYKRS MDPGYPKMIA
Theropithecus_gelada        KYWAVQGQNV LPGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK CWRYDEYKRS MDPGYPKMIA
Trachypithecus_francoisi    KYWAVQGQNV LRGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYERS MDPGYPKMIA
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Homo_sapiens                  HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Mus_musculus                  EDFPGIDDKV DDVFQKGENF YFFHQSVQHR FNLQIRRVDD SRDSSTWFNC ---
Aotus_nancymaae               DDFPGIGHKV DAVFMKDGFF YFFHKTRQYK FEPETKRILT LQKANSWFNC RKN
Carlito_syrichta              HGFPGIGHKV DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKN
Cebus_imitator                HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Gorilla_gorilla               HDFPGIGHKV DAVFMKDGFF YFFRGRRQYK FDPETKRILT LQKANSWFNC RKN
Lemur_catta                   LDFPGIGHKI DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKK
Macaca_mulatta                HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Macaca_nemestrina             HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Microcebus_murinus            HDFPGIGHKI DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKN
Nomascus_leucogenys           HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Nycticebus_coucang            HDFPGIGHKV DAVFKKDEFF YFFHGTRQYK FDLKTKRILT LLKANSWFNC RKH
Otolemur_garnettii            HDFPGIGHKV DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKH
Pan_paniscus                  HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Pan_troglodytes               HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Papio_anubis                  HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Piliocolobus_tephrosceles     HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Pongo_abelii                  HDFPGIGHKV DAVFTKDGFF YFFHGTRQYK FDPETKRILT LQKANSWFNC RKN
Pongo_pygmaeus                HDFPGIGHKV DAVFTKDGFF YFFHGTRQYK FDPETKRILT LQKANSWFNC RKN
Saimiri_boliviensis           HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Sapajus_apella                HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Symphalangus_syndactylus      HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Theropithecus_gelada          HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Trachypithecus_francoisi      HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
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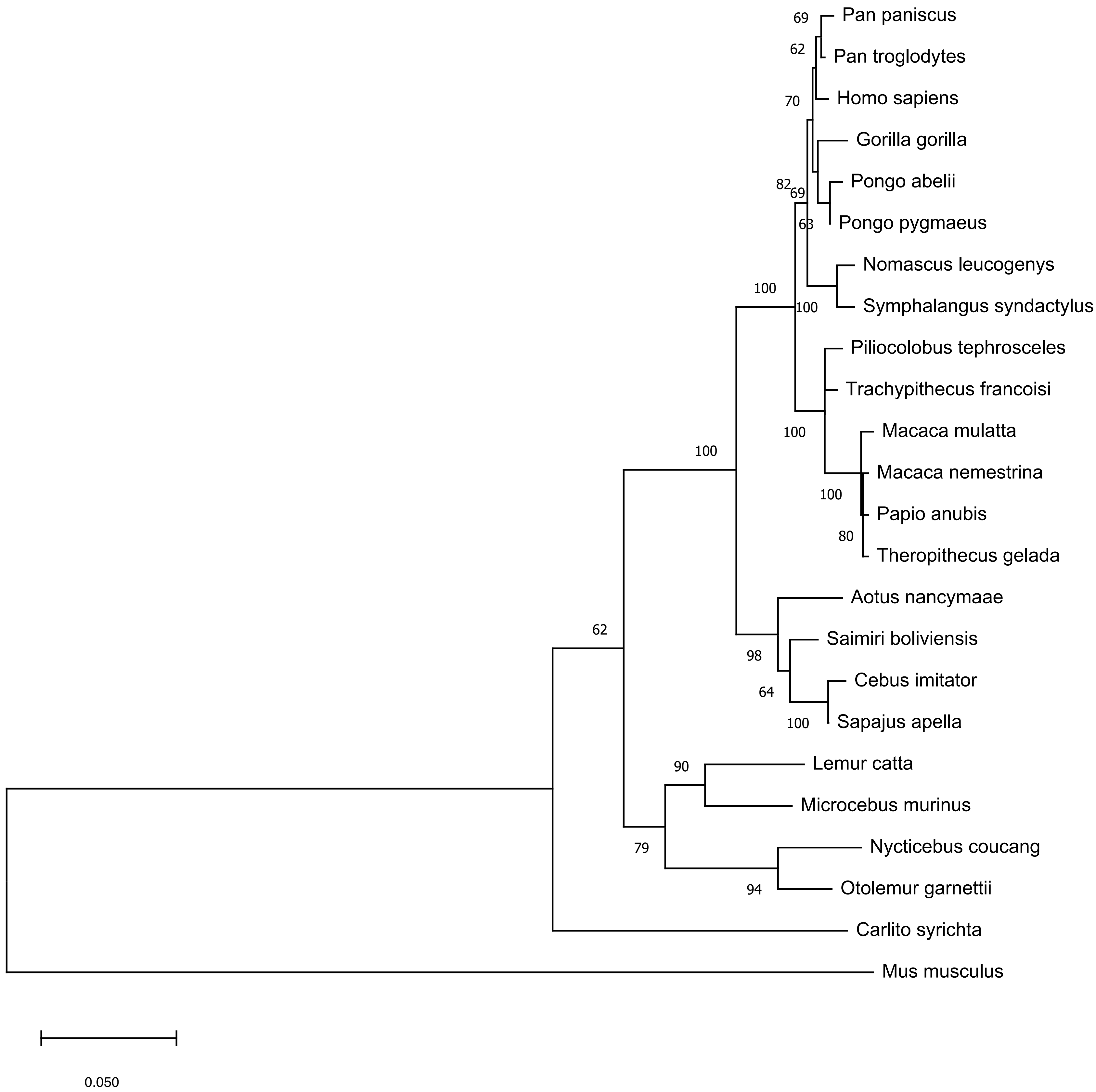
Pan paniscus
Pan troglodytes
Homo sapiens
Gorilla gorilla
Pongo abelii
Pongo pygmaeus
Nomascus leucogenys
Symphalangus syndactylus
Piliocolobus tephrosceles
Trachypithecus francoisi
Macaca mulatta
Macaca nemestrina
Papio anubis
Theropithecus gelada
Aotus nancymaae
Saimiri boliviensis
Cebus imitator
Sapajus apella
Lemur catta
Microcebus murinus
Nycticebus coucang
Otolemur garnettii
Carlito syrichta
Mus musculus
69
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Mus_musculus                MFRLKTLPLL IFLHTQLANA FPVPEHLEEK NIKTAE---- -------NYLR KFYNLPSNQF RSSRN--ATM
Aotus_nancymaae             MFCLKTLPFL LLLHVQISKA FPVSS--KEK DTKIVQ---- -------DYLE KFYQLPSNQY QSIRKNSINM
Carlito_syrichta            MFSLQMLLFL LLLHMQVATA FPTPS--EEK STTMVQ---- -------DYLE KFYQLPSSRY RSARKNSTSM
Cebus_imitator              MFCLKTLPFL LLLHVQISKA FPVSS--KEK DTKIVQ---- -------DYLE KFYQLPSNQH QSIRKNSINM
Gorilla_gorilla             MFSLKTLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Lemur_catta                 MFYLKTLPFL LLLHMELSKA FPVPS--EEK NAKIVQ---- -------DYLE KFYRLPSNQY RTARKNSPST
Macaca_mulatta              MFSLKMLLFL LLLHVQISKA FPVSS--KEE NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTSM
Macaca_nemestrina           ---------- -------MQQ IP-------- QEKSIN---- -------DYLE KFYQLPSNQY QSTRKNGTSM
Microcebus_murinus          MFCLKTLPLL LLLHMELSKA FPVPS--EGR NAKIVQ---- -------DYLE KFYRLPSNQY RTARKNSASM
Nomascus_leucogenys         MFALKTLPFL LLLHVHISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Nycticebus_coucang          MFCLKTLLFL LLLHVQLSKT FPVVS--AEK NTKLIQ---- -------DYLE KFYQLPSNRY RTSRKNSTTM
Otolemur_garnettii          MFRLKTLVFL LLLHVPLSKT FPVVS--AEK NTKLIQ---- -------DYLE KFYQLPSNRY RTSRKNSTTM
Pan_paniscus                MFSLKTLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Pan_troglodytes             MFSLKMLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Papio_anubis                MFSLKMLPFL LLLHVQISKA FPVSS--KEE NTKIVQ---- -------DYLE KFYQLPSNQY QSMRKNGTSM
Piliocolobus_tephrosceles   MFSLKTLPFL FLLHVQISKA FPVSS--KEE NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTSM
Pongo_abelii                MFSLKTLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Pongo_pygmaeus              -MCRFPRPFL YLLKRKIQKL FSTRP--SQK PTRCSHLILD FPASKIDYLE KFYQLPSNQY QSTRKNGTNV
Saimiri_boliviensis         MFCLKRLPFL LLLHVQISKA FPVSF--KEK DTKIVQ---- -------DYLE KFYQLPSNQY QSIRKNSINM
Sapajus_apella              MFCLKTLPFL LLLHVQISKA FPVSS--KEK DTKIVQ---- -------DYLE KFYQLPSNQY QSIRKNSINM
Symphalangus_syndactylus    MFALKTLPFL LLLHVHISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Theropithecus_gelada        MFSLKMLPFL LLLHVQISKA FPVSS--KEE NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTSM
Trachypithecus_francoisi    MFSLKTLPFL LLLHVQISKA FPLSS--KEE NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTSM
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                            71
Homo_sapiens                IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGG FMLTPGNPKW ERTNLTYRIR NYTPQLSEAE
Mus_musculus                VAEKLKEMQR FFSLAETGKL DAATMGIMEM PRCGVPDSGD FLLTPGSPKW THTNLTYRII NHTPQLSRAE
Aotus_nancymaae             IVEKLKEMQR FFGLNVTGKP NAETLEMMKQ PRCGVPDSGD FMITPGNPKW EQTNLTYRII NYTPQLSETE
Carlito_syrichta            IVEKLKEMQR FFGLNVTGKP DAETLETMEK PRCGVPDRGD FMLTPGNPKW KHTNLTYRII NYTPQLSEAD
Cebus_imitator              IVEKLKEMQQ FFGLNVTGKP NAETLEMMKQ PRCGVPDSGD FMITPGNPKW EQTNLTYRII NYTPQLSETE
Gorilla_gorilla             IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGG FMLTPGNPKW EHTNLTYRIR NYTPQLSVAE
Lemur_catta                 IVEKLKEMQR FFRLNVTGKP DAETLEVMEK PRCGVPDSGD FAITPGNPKW EHTNLTYRII SYTQQLSEAD
Macaca_mulatta              IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMLTPGNPKW ERTNLTYSIL NYTPQLSETD
Macaca_nemestrina           IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMLTPGNPKW ERTNLTYSIL NYTPQLSETD
Microcebus_murinus          VVEKLKEMQR FFGLNVTGKP DAETLEVMEK PRCGVPDSSS FMITPGSPKW EHTNVTYRII SHTQQLSVAE
Nomascus_leucogenys         IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMITPGNPKW ERTNLTYRIR NYTPQLSKAD
Nycticebus_coucang          IVEKLKEMQR FFGLNVTGKP NAETLEMMEK PRCGVPDTAG FVLTPGNPKW EHINLTYRFI NYTPQLSKTD
Otolemur_garnettii          IVEKLKEMQR FFGLNVTGKP NAETLEMMEK PRCGVPDTAG FMLTPGSPKW EHTNLTYRFI NYTPQLSKTD
Pan_paniscus                IIEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGG FMLTPGNPKW ERTNLTYRIR NYTPQLSEAE
Pan_troglodytes             IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGG FMLTPGNPKW EHTNLTYRIR NYTPQLSEAE
Papio_anubis                IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMLTPGNPKW EHTNLTYRIL NYTPQLSETD
Piliocolobus_tephrosceles   IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDTGD FMLTPGNPKW KHTNLTYSIL NYTPQLSQTD
Pongo_abelii                IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGE FMLTPGNPKW ERTNLTYRIR NYTPQLSEDD
Pongo_pygmaeus              IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGE FMLTPGNPKW ERTNLTYRIR NYTPQLSEDD
Saimiri_boliviensis         IVEKLKEMQR FFGLNVTGKP DAETLEMMKQ PRCGVPDSGD FMITPGNPKW EQTNLTYRFI NYTPQLSVTE
Sapajus_apella              IVEKLKEMQQ FFGLNVTGKP NAETLEMMKQ PRCGVPDSGD FMITPGNPKW EQTNLTYRII NYTPQLSETE
Symphalangus_syndactylus    IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMITPGNPKW ERTNLTYRIR NYTPQLSKTD
Theropithecus_gelada        IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMLTPGNPKW ERTNLTYRIL NYTPQLSETD
Trachypithecus_francoisi    IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDTGD FMLTPGNPKW KHTNLTYSIL NYTPQLSKTD
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Homo_sapiens                   VERAIKDAFE LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Mus_musculus                   VKTAIEKAFH VWSVASPLTF TEILQGEADI NIAFVSRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDS
Aotus_nancymaae                VETAIGNAFK VWSNASSLTF TRISQGEANI SIAFFHRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDA
Carlito_syrichta               VDSAIERAFE LWSHASPLRF TRISQGEPDI KIAFVQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Cebus_imitator                 VERAIGDAFK VWSDVSPLTF TRISQGEADI NIAFYQKDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Gorilla_gorilla                VERAIKDAFE LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Lemur_catta                    VETAIEKAFK VWSDVSPLTF TRISRGEADI KIAFYLRDHG DNSPFDGPNG ILAHAFQPGR GIGGDVHFDA
Macaca_mulatta                 VEGAIKKAFE VWSKASPLTF TRISQGQADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Macaca_nemestrina              VEGAIKKAFE VWSKASPLTF TRISQGQADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Microcebus_murinus             VGAAFEKAFK LWSGASPLTF TRISQGEADI KIAFVQRDHG DNSPFDGPNG ILAHAFQPGP GIGGDVHFDA
Nomascus_leucogenys            VERAIEKAFK VWSDASPLTF TRISQGEADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Nycticebus_coucang             VETVIEKAFE VWSKASPLTF TKISQGEADI KIAFVRREHG DNSPFDGPNG ILAHAFQPGR GIGGDVHFDE
Otolemur_garnettii             VETVIEKAFE VWSKASPLTF TKTAQGEADI KIAFVQKDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDE
Pan_paniscus                   VERAIKDAFK LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Pan_troglodytes                VERAIKDAFE LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Papio_anubis                   VEGAIKKAFE VWSKASPLTF TRISQGQADI NIGFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Piliocolobus_tephrosceles      VEGTIKKAFE VWSKVSPLTF TRISQGDADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Pongo_abelii                   VKTAIEKAFE VWSKASPLTF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDA
Pongo_pygmaeus                 VKTAIEKAFE VWSKASPLTF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDA
Saimiri_boliviensis            VETAIGNAFK IWSDPSPLTF TRISQGEADI NIAFFPRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Sapajus_apella                 VETAIGDAFK VWSDVSPLTF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Symphalangus_syndactylus       VERAIEKAFK VWSDASPLTF TRISQGEADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Theropithecus_gelada           VEGAIKKAFE VWSKASPLTF TRISQGQADI NIGFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Trachypithecus_francoisi       IEGAIKKAFE VWSKVSPLTF TRISQGEADI NIGFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
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Mus_musculus                  EETWTQDSKN YNLFLVAAHE FGHSLGLSHS TDPGALMYPN YAYREPSTYS LPQDDINGIQ TIYGPSDNPI
Aotus_nancymaae               EETWTSTSKN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYS LPQDDINGIQ AIYGPSSNPI
Carlito_syrichta              EETWTKTSAN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYL LPQDDINGIQ AIYGPSDNPI
Cebus_imitator                EETWTNTSEN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYS LPQDDINGIQ AIYGPSSNPI
Gorilla_gorilla               EETWTNTSAS YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDIDGIQ AIYGLSSNPI
Lemur_catta                   EETWTTNANN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFREPSTYT LPQDDINGIQ AIYGPSSNPV
Macaca_mulatta                EETWTKTSTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Macaca_nemestrina             EETWTKNSTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Microcebus_murinus            EETWTTNFNN YNLFLVAAHE FGHSLGLAHS SDAGALMYPN YAFSEPSTYT LPQDDINGIQ AIYGPSNNPI
Nomascus_leucogenys           EETWTKTSTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSTYS LPQDDIDGIQ AIYGPSSNPI
Nycticebus_coucang            EETWTTTAVN YNLFLVAAHE FGHSLGLSHS TDPGALMYPN YAFNDPSTYS LPQDDINGIQ AIYGPSSSPV
Otolemur_garnettii            EETWTTTSIN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFNEPSTYS LPQDDINGIQ AIYGPSNSPV
Pan_paniscus                  EETWTDTSAN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDIDGIQ AIYGLSSNPI
Pan_troglodytes               EETWTDTSAN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDIDGIQ AIYGLSSNPI
Papio_anubis                  EETWTKDFTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Piliocolobus_tephrosceles     EETWTTNSTN YNLFLVAAHE FGHSLGLAHS FDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Pongo_abelii                  EETWTKTSAN YNLFIVAAHE FGHSLGLAHS SDPGALMYPN YAFTETSNYS LPQDDIDGIQ AIYGPSSNPV
Pongo_pygmaeus                EETWTKTSAN YNLFIVAAHE FGHSLGLAHS SDPGALMYPN YAFTETSNYS LPQDDIDGIQ AIYGPSSNPV
Saimiri_boliviensis           EETWTSTSEN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYS LPQDDINGIQ AIYGPSSNPI
Sapajus_apella                EETWTNTPEN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYS LPQDDINGIQ AIYGPSSNPI
Symphalangus_syndactylus      EETWTKTSAN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSTYS LPQDDIDGIQ AIYGPSSNPI
Theropithecus_gelada          EETWTKDFTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Trachypithecus_francoisi      EETWTTNSTN YNLFLVAAHE FGHSLGLAHS FDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
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                           281
Homo_sapiens               QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Mus_musculus               QPTGPSTPKA CDPHLRFDAT TTLRGEIYFF KDKYFWRRHP QLRTVDLNFI SLFWPFLPNG LQAAYEDFDR
Aotus_nancymaae            QPTGPSTPRP CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Carlito_syrichta           QPTGPSTPRT CDPRLTFDAI TTLRGEIFFF RDKYFWRRHP QLRSIEFNFI SLFWPALPDS IQAAYEDLDR
Cebus_imitator             QPTGPSTPRP CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Gorilla_gorilla            QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Lemur_catta                QPTGPSTPRS CDPRLTFDAI TTLRGEILFF KDKYFWRRHP QLRSVELNFI SLFWPNLPNG IQAAYEDFDR
Macaca_mulatta             QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Macaca_nemestrina          QPTGPTTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Microcebus_murinus         QPTGPSTPMA CDPRLTFDAI TTLRGEIFFF KDKYFWRRHP QLRSVELNFI SLFWPSLPNG IQAAYEDFDK
Nomascus_leucogenys        QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDSDR
Nycticebus_coucang         QPTGPSTPRT CDPRLTFDAI TTLRGEILFF KDKYFWRKHP QLPTVELNFI SLFWPSLPNG IQAAYEDFDR
Otolemur_garnettii         QPTGPSTPRT CDPRLTFDAI TTLRGEILFF KDKYFWRKHP QLPTAELNFI SLFWPSLPNG IQAAYEDFER
Pan_paniscus               QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Pan_troglodytes            QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Papio_anubis               QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Piliocolobus_tephrosceles  QPTGPSTPES CDPRLTFDAI TTLRGEILFF KDEYFWRRHP WLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Pongo_abelii               QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRIEMNFI SLFWPSLPTG MQAAYEDFDR
Pongo_pygmaeus             QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRIEMNFI SLFWPSLPTG MQAAYEDFDR
Saimiri_boliviensis        QPTGPSTPRS CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLRRVEMNFI SLFWPSLPTG IQAAYEDFDR
Sapajus_apella             QPTGPSTPRP CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Symphalangus_syndactylus   QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Theropithecus_gelada       QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Trachypithecus_francoisi   QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
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Homo_sapiens                DLIFLFKGNQ YWALSGYDIL QGYPKDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Mus_musculus                DLVFLFKGRQ YWALSGYDLQ QGYPRDISNY GFPRSVQAID AAVSYNGKTY FFINNQCWRY DNQRRSMDPG
Aotus_nancymaae             DLVFLFKGNQ YWALSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Carlito_syrichta            DLVFLFKGNQ YWAMNGYDLQ PGYPRDISNY GFPSNVQAID AAVYFRSKTY FFVNDQFWRY DNERQTMEPG
Cebus_imitator              DLVFLFKGNQ YWALSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQLMEPG
Gorilla_gorilla             DLIFLFKGNQ YWALSGYDIL QGYPKDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Lemur_catta                 DLVFLFKGNQ YWALSGYDIQ QGYPRYISNY GFPSTVQAID AAVSYGSETY FFVNDQFWRY DNQRQAMDPG
Macaca_mulatta              DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Macaca_nemestrina           DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Microcebus_murinus          DLVFLFKGNQ YWAMSGYDIQ QGYPRHISNY GFPSNVQAID AAVSYGRKTY FFVNDQLWRY DNQRQAMDPG
Nomascus_leucogenys         DLIFLFKGNQ YWALSGYDIQ QGYPKSISNY GFPCSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Nycticebus_coucang          DLVFLFKGNQ YWALNGYDIQ EGYPRDISNY GFPSTVQAID AAVSYRRKTY FFVNDQFWRY DNQRQLMEPG
Otolemur_garnettii          DLVFLFKGNQ YWALNGYEIQ QGYPRDISNY GFPSTVQAVD AAVFYRRKTY FFVNDQFWRY DNQRQFMEPG
Pan_paniscus                DLIFLFKGNQ YWALSGYDIL QGYPKDIANY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Pan_troglodytes             DLIFLFKGNQ YWALSGYDIL QGYPKDIANY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Papio_anubis                DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Piliocolobus_tephrosceles   DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Pongo_abelii                DLIFLFKGNQ YWALSGYDIL QGYPKNISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Pongo_pygmaeus              DLIFLFKGNQ YWALSGYDIL QGYPKNISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Saimiri_boliviensis         DLVFLFKGNQ YWALSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYKSKTY FFVNDQFWRY DNQRQFMEPG
Sapajus_apella              DLVFLFKGNQ YWALSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQLMEPG
Symphalangus_syndactylus    DLIFLFKGNQ YWALSGYDIQ QGYPKSISNY GFPCSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Theropithecus_gelada        DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Trachypithecus_francoisi    DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
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Homo_sapiens               YPKSISGAFP GIESKVDAVF QQEHFFHVFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Mus_musculus               YPKSIPSMFP GVNCRVDAVF LQDSFFLFFS GPQYFAFNFV SHRVTRVARS NLWLNCS--
Aotus_nancymaae            YPQSISYIFP GIESKVDAVF QQEHFFLFFS GPLYYAFDLS AQRVTRVARG NKWLNCR--
Carlito_syrichta           YPKSTLSIFP GIESKVDAVF QQNYFFFFFS GPRFYAFDLQ AHRVTRVDRS NRWLNCR--
Cebus_imitator             YPQRISDIFP GIERKVDAVF QQEHFFLFFS GPIYYAFDLS AQRVTRVARG NKWLNCR--
Gorilla_gorilla            YPKSISGAFP GIESKVDAVF QQQHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Lemur_catta                YPQSILRTFP GIQSKVDAVF QKDDFFLFFS GPLYYAFNLS TRRVTRIDRS NKWLNCR--
Macaca_mulatta             YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Macaca_nemestrina          YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Microcebus_murinus         YPQSISSTFP GIQSRVDAVF QQDDFFLFFS GPRYYAFNLS TNRVTRLDKS NKWLNCR--
Nomascus_leucogenys        YPKSISGTFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVERG NKWLNCRYG
Nycticebus_coucang         YPKSLSTAFP GIESRVDAVF QRDYVFLFFS GPRYYAFDLN TRRVIRIDRS NIWLNCR--
Otolemur_garnettii         YPKSISTAFP GIESRVDAVF HRDYVFVFFS GPRYYAFDLN TRRVIRIDRS NKWLNCR--
Pan_paniscus               YPKSISGAFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Pan_troglodytes            YPKSISGAFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Papio_anubis               YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Piliocolobus_tephrosceles  YPKSTSGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTTVARA NEWLNCRYS
Pongo_abelii               YPKSISDTFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Pongo_pygmaeus             YPKSISDTFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCR--
Saimiri_boliviensis        YPQSISGIFP GIESKVDAVF QQEHFFLFFS GPIYYAFDLS AQRVTKIARG NKWLNCR--
Sapajus_apella             YPQRISDIFP GIERKVDAVF QQEHFFLFFS GPIYYAFDLS AQRVTRVARG NKWLNCR--
Symphalangus_syndactylus   YPKSISDTFP GIESKVDAVF QQERFFLFFS GPRYYAFDLI AQRVTRVERG NKWLNCRYG
Theropithecus_gelada       YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Trachypithecus_francoisi   YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
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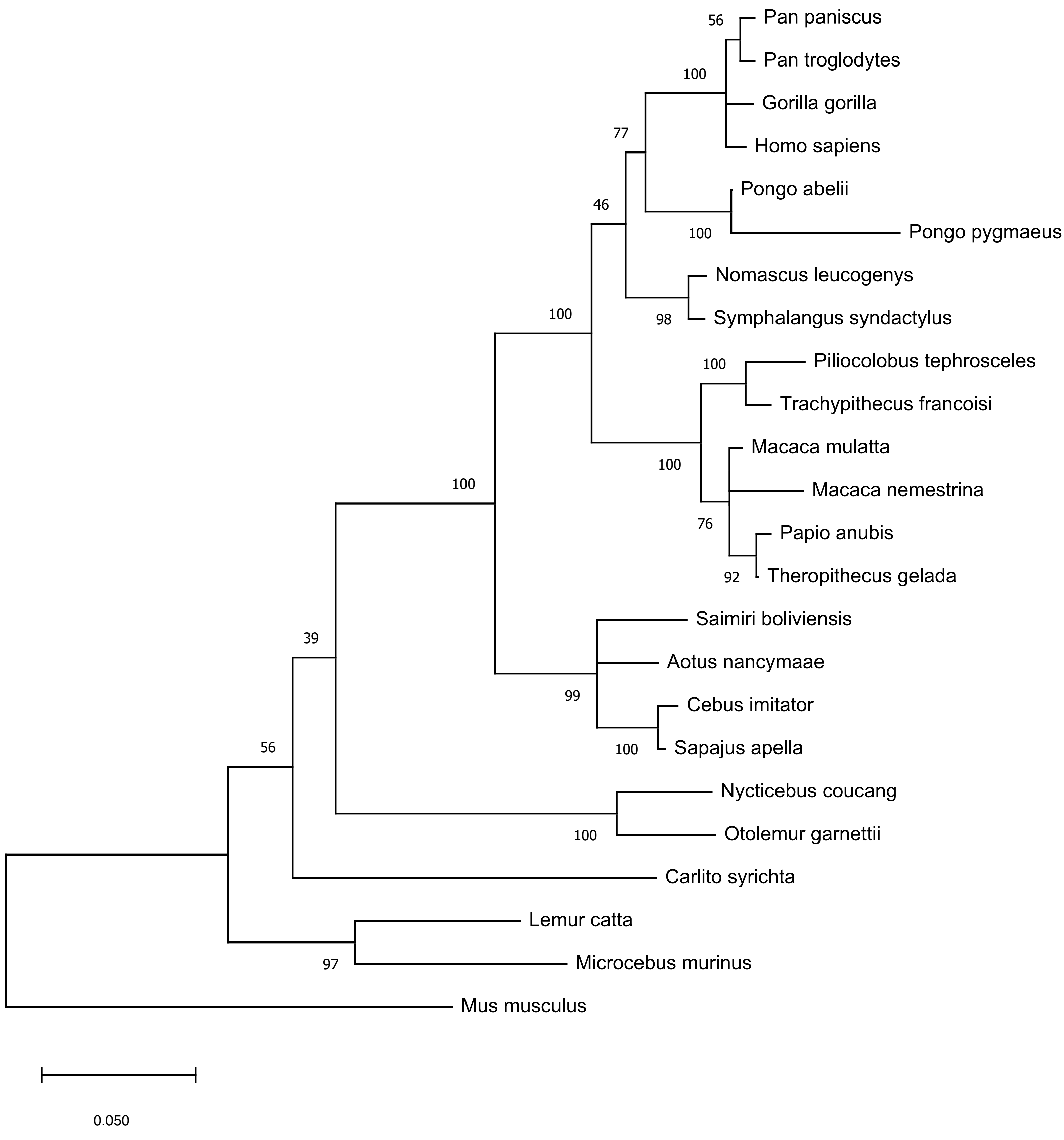

56
Pan paniscus
Pan troglodytes
100
Gorilla gorilla
77
Homo sapiens
Pongo abelii
46
100
Pongo pygmaeus
Nomascus leucogenys
100
98
Symphalangus syndactylus
100
Piliocolobus tephrosceles
Trachypithecus francoisi
Macaca mulatta
100
100
Macaca nemestrina
76
Papio anubis
92
Theropithecus gelada
Saimiri boliviensis
39
Aotus nancymaae
99
Cebus imitator
56
100
Sapajus apella
Nycticebus coucang
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Otolemur garnettii
Carlito syrichta
Lemur catta
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Microcebus murinus
Mus musculus
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Mus_musculus                  MHSAILATFF LLSWTPCWSL PLPYGDDDDD DLSEEDLVFA EHYLKSYYHP ATLAGILKKS TVTSTVDRLR
Aotus_nancymaae               MHLGVLAAFL FLNWTHCRAL PLPNG-DDED DLSEEDLQFA ERYLKLYYHP TNLAGILKKN SANSMADRLR
Carlito_syrichta              MHPGVLTAFL LLCWTQCQSL PLPNG-EDED DTSEEDLQFA ERYLRSFYHP VNLAGILKKN AASSMVDRLR
Cebus_imitator                MHPGVLAAFL FLSWTHCWAL PLPNG-DDED DLSEEDLQFA ERYLKLYYHP TNLAGILKKN SASSMTDRLR
Gorilla_gorilla               MHPGVLAAFL FLSWTHSRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Lemur_catta                   MHPGILVAFL FLSWTHCRSL PLPNG--DDD DLSEEDLQFA ERYLKSYYHP PNLAGILKET SASSMVDRLR
Macaca_mulatta                MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Macaca_nemestrina             MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Microcebus_murinus            -MQGVLVAFL FLSWTHCRSL PLPDG--DDD DLSEEDLQFA ERYLKSYYHP PILAGILKKT SASSMVDRLR
Nomascus_leucogenys           MHPGILAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Nycticebus_coucang            MLPGVLLAFL FLSWTHCRAL PLPND-DDDD DLSEEDLQFA ERYLKSYYYP PNLAGILKKT SASSMIDRLR
Otolemur_garnettii            MLPRVLLAFL FLSWTPCRAL PLPNG--DDD DLSEEDLQFA EHYLKSYYHP LNLAGILKKT SASSMIDRLR
Pan_paniscus                  MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTERLR
Pan_troglodytes               MHPGVLAAFL FLSWAHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTERLR
Papio_anubis                  MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Piliocolobus_tephrosceles     MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Pongo_abelii                  MHPGVLAAFL FLSWTHCRAL PLPSD-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Pongo_pygmaeus                MHPGVLAAFL FLSWTHCRAL PLPSD-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Saimiri_boliviensis           MHPGVLAAFL FLSWTHCRAL PLPNG-DDED DLSEEDLQFA ERYLKLYYHP TNLAGILKKN SASSMTDRLR
Sapajus_apella                MHPGVLAAFL FLSWTHCWAL PLPNG-DDED DLSEEDLQFA EHYLKLYYHP TNLAGILKKN SASSMTDRLR
Symphalangus_syndactylus      MHPGILAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Theropithecus_gelada          MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Trachypithecus_francoisi      MHPVVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
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| | 71 | | | | | | |
|---|---|---|---|---|---|---|---|
| Homo_sapiens | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Mus_musculus | EMQSFFGLEV | TGKLDDPTLD | IMRKPRCGVP | DVGEYNVFPR | TLKWSQTNLT | YRIVNYTPDM | SHSEVEKAFR |
| Aotus_nancymaae | EMQSFFGLEV | TGKLDDNTLD | IMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Carlito_syrichta | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIENYTPDM | PHSEVEKAFK |
| Cebus_imitator | EMQSFFGLEV | TGKLDDNTLD | IMKKPRCGVP | DVGEYNVFPR | TLKWPKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Gorilla_gorilla | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Lemur_catta | EMQSFFGLEV | TGKLDDNTLD | IMKKPRCGVP | DVGEYNVFPR | TLKWTQTNLT | YRIVNYTPDM | PHSEVEKAFK |
| Macaca_mulatta | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Macaca_nemestrina | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Microcebus_murinus | EMQSFFGLEV | TGKLDDNTLD | IMKKPRCGVP | DVGEYNVFPR | TLKWTQTNLT | YRIVNYTPDM | THSEVEKAFK |
| Nomascus_leucogenys | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Nycticebus_coucang | EMQSFFGLEV | TGKLDDNTLD | IMKKPRCGVP | DVGEYNVFPR | TLKWTKTNLT | YRIVNYTPDM | THSEVEKAFK |
| Otolemur_garnettii | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWTKTNLT | YRIVNYTPDM | THSEVEKAFK |
| Pan_paniscus | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Pan_troglodytes | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Papio_anubis | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Piliocolobus_tephrosceles | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Pongo_abelii | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Pongo_pygmaeus | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Saimiri_boliviensis | EMQSFFGLEV | TGKLDDNTLD | IMKKPRCGVP | DVGEYNVFPR | TLKWSRMNLT | YRIVNYTPDM | THSEVEKAFK |
| Sapajus_apella | EMQSFFGLEV | TGKLDDNTLD | IMKKPRCGVP | DVGEYNVFPR | TLKWPKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Symphalangus_syndactylus | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Theropithecus_gelada | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Trachypithecus_francoisi | EMQSFFGLEV | TGKLDDNTLD | IMKKPRCGVP | DVGEYNVFPR | TLKWSKVNLT | YRIVNYTPDM | THSEVEKAFK |

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Mus_musculus                   KAFKVWSDVT PLNFTRIYDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Aotus_nancymaae                KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Carlito_syrichta               KAFKVWSDVT PLNFTRMHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Cebus_imitator                 KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Gorilla_gorilla                KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Lemur_catta                    KAFKVWSDVT PLNFTRLHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Macaca_mulatta                 KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Macaca_nemestrina              KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Microcebus_murinus             KAFKVWSDVT PLNFTRLHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNLGGDA HFDDDETWTS
Nomascus_leucogenys            KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Nycticebus_coucang             KAFKVWSDVT PLNFTRLHDG TADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Otolemur_garnettii             KAFKVWADVT PLNFTRLHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pan_paniscus                   KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pan_troglodytes                KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Papio_anubis                   KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Piliocolobus_tephrosceles      KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pongo_abelii                   KAFKVWSDVT PLNFTRLHNG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pongo_pygmaeus                 KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Saimiri_boliviensis            KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Sapajus_apella                 KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Symphalangus_syndactylus       KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Theropithecus_gelada           KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Trachypithecus_francoisi       KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
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| | 211 | | | | | | |
|---|---|---|---|---|---|---|---|
| Homo_sapiens | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Mus_musculus | SSKGYNLFIV | AAHELGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQFLYGPG | DEDPNPKHPK |
| Aotus_nancymaae | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQFLYGPG | DEDPNPKHPK |
| Carlito_syrichta | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | NHFVLPDDDV | QGIQTLYGPG | DEDPNPKHPK |
| Cebus_imitator | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTSK | SHFMLPDDDV | QGIQFLYGPG | DEDPNPKHPK |
| Gorilla_gorilla | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Lemur_catta | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFVLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Macaca_mulatta | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Macaca_nemestrina | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Microcebus_murinus | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFVLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Nomascus_leucogenys | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Nycticebus_coucang | SSKGYNLFLV | AAHELGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPEDDV | QGIQFLYGPG | DEDPNPKHPK |
| Otolemur_garnettii | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFVLPEDDV | QGIQSLYGPG | DEDPNPKHPK |
| Pan_paniscus | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Pan_troglodytes | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Papio_anubis | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFVLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Piliocolobus_tephrosceles | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Pongo_abelii | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Pongo_pygmaeus | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Saimiri_boliviensis | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTSK | NHFMLPDDDV | QGIQFLYGPG | DEDPNPKHPK |
| Sapajus_apella | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTSK | SHFMLPDDDV | QGIQFLYGPG | DEDPNPKHPK |
| Symphalangus_syndactylus | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Theropithecus_gelada | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFVLPDDDV | QGIQSLYGPG | DEDPNPKHPK |
| Trachypithecus_francoisi | SSKGYNLFLV | AAHEFGHSLG | LDHSKDPGAL | MFPIYTYTGK | SHFMLPDDDV | QGIQSLYGPG | DEDPNPKHPK |

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                            281
Homo_sapiens                TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Mus_musculus                TPEKCDPALS LDAITSLRGE TMIFKDRFFW RLHPQQVEAE LFLTKSFWPE LPNHVDAAYE HPSRDLMFIF
Aotus_nancymaae             TPDKCDPSLS LDAITSLRGE TMVFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSRDLIFIF
Carlito_syrichta            TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSRDLIFIF
Cebus_imitator              TPDKCDPSLS LDAITSLRGE TMVFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Gorilla_gorilla             TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSYDLIFVF
Lemur_catta                 TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPAHDLVFVF
Macaca_mulatta              TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Macaca_nemestrina           TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Microcebus_murinus          TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLVFFF
Nomascus_leucogenys         TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Nycticebus_coucang          TPDKCDPSLS LDAITSLRGE TIIFKDRFFW RLHPQQVDAE LFLTKSFWME LPNRIDAAYE HPSHDLVFIF
Otolemur_garnettii          TPDKCDPSLS LDAITNLRGE TIIFKDRFFW RLHPQQVDAE LFLTKSFWLE LPNRIDAAYE HPSHDLVFIF
Pan_paniscus                TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Pan_troglodytes             TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Papio_anubis                TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Piliocolobus_tephrosceles   TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Pongo_abelii                TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Pongo_pygmaeus              TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Saimiri_boliviensis         TPDKCDPSLS LDAITSLRGE TMVFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Sapajus_apella              TPDKCDPSLS LDAITSLRGE TMVFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Symphalangus_syndactylus    TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Theropithecus_gelada        TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Trachypithecus_francoisi    TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
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                               351
Homo_sapiens                   RGRKFWALNG YDILEGYPKK ISELGLPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Mus_musculus                   RGRKFWALNG YDILEGYPRK ISDLGFPKEV KRLSAAVHFE NTGKTLFFSE NHVWSYDDVN QTMDKDYPRL
Aotus_nancymaae                RGRKFWALNG YDILEGYPKK ISELGFPKEI KKISAAVHFE DTGRTLFFSG NHVWRYDDTN QIMDKDYPRL
Carlito_syrichta               RGRKFWALNG YDIMEGYPQK ISELGFPKEV KKISAAVHFE DTGKTLFFSG NQVWSYDDTN HVMDKDYPRF
Cebus_imitator                 RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGRTLFFSG NQVWRYDDTN QIMDKDYPRL
Gorilla_gorilla                RGRKFWALNG YDILEGYPKK ISELGLPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Lemur_catta                    RGRKFWALNG YDIMEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLFFSG NQVWRYDDTN HIMDTDYPRL
Macaca_mulatta                 RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Macaca_nemestrina              RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Microcebus_murinus             RGRKFWALNG YDIMEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLFFSG NQVWRYDDTN QIMDKDYPRL
Nomascus_leucogenys            RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Nycticebus_coucang             RGRKFWALNG YDIMEGYPKK ISELGFPKEV KKISAAVHFE DRGKTLFFSG NQVWSYDDTN HIMDKDYPRL
Otolemur_garnettii             RGRKFWALNG YDIMEGYPKK ISELGFPKEV KKISAAVHFE DRGKTLFFSG NQVWSYDDTN HIMDKDYPRL
Pan_paniscus                   RGRKFWALNG YDILEGYPKK ISELGLPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Pan_troglodytes                RGRKFWALNG YDILEGYPKK ISELGLPKEV KKISATVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Papio_anubis                   RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Piliocolobus_tephrosceles      RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Pongo_abelii                   RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Pongo_pygmaeus                 RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Saimiri_boliviensis            RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLFFSG NQVWRYDDTN QIMDKDYPRL
Sapajus_apella                 RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGRTLFFSG NQVWRYDDTN QIMDKDYPRL
Symphalangus_syndactylus       RGRKFWALNG YDILEGYPQK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Theropithecus_gelada           RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Trachypithecus_francoisi       RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
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                             421
Homo_sapiens                 IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Mus_musculus                 IEEEFPGIGN KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPTNSIL
Aotus_nancymaae              IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSKRI VRVMPANSIL
Carlito_syrichta             IEEVFPGIGD KVDAVYEKNG YIYFFNGPIQ FEF------- ---------- ---SVWSKRI VRVMTANSLL
Cebus_imitator               IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSKRI VRVMPANSIL
Gorilla_gorilla              IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Lemur_catta                  IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPTNSLL
Macaca_mulatta               IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Macaca_nemestrina            IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Microcebus_murinus           IEEDFPGIGD KVDAVYEKNG YIYFFSGPIQ FEY------- ---------- ---SIWSNRI VRVMPTNSLL
Nomascus_leucogenys          IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Nycticebus_coucang           IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSDRI VRVMPTNALL
Otolemur_garnettii           IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPTNALL
Pan_paniscus                 IEEEFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Pan_troglodytes              IEEEFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Papio_anubis                 IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Piliocolobus_tephrosceles    IEEDFPGIGD KVDAVYEKNG YIYFFNGPTQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Pongo_abelii                 IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Pongo_pygmaeus               IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Saimiri_boliviensis          IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSKRI VRVMPANSIL
Sapajus_apella               IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSKRI VRVMPANSIL
Symphalangus_syndactylus     IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Theropithecus_gelada         IEEDFPGIGD KVDAVYEKNE SHFVVQAGVQ WHNLSSLQPP PPGFKRFSCL SLRSSWNYRL YLFFQRAHTV
Trachypithecus_francoisi     IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
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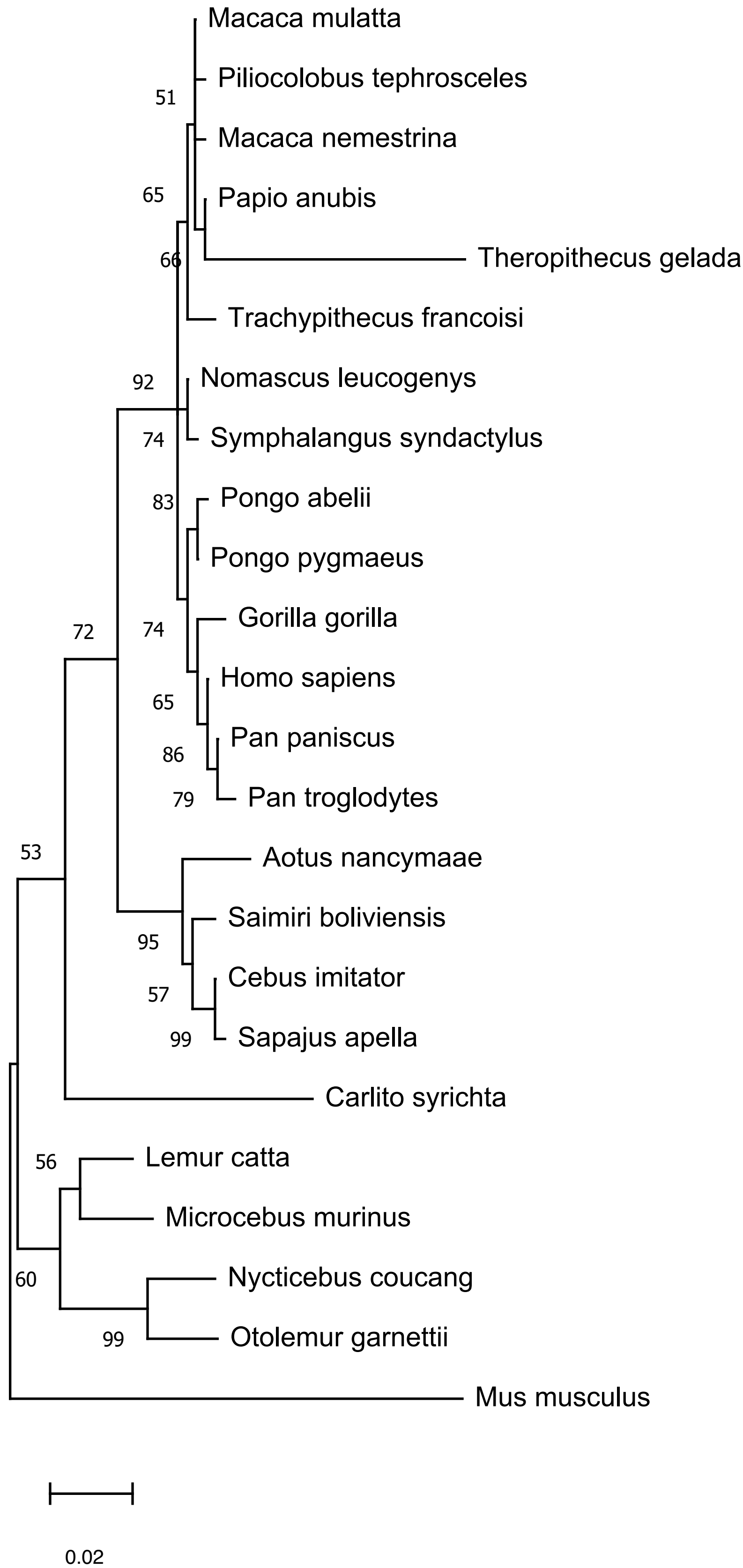
| | 491 |
|---|---|
| Homo_sapiens | WC |
| Mus_musculus | WC |
| Aotus_nancymaae | WC |
| Carlito_syrichta | WC |
| Cebus_imitator | WC |
| Gorilla_gorilla | WC |
| Lemur_catta | WC |
| Macaca_mulatta | WC |
| Macaca_nemestrina | LC |
| Microcebus_murinus | WC |
| Nomascus_leucogenys | WC |
| Nycticebus_coucang | WC |
| Otolemur_garnettii | WC |
| Pan_paniscus | WC |
| Pan_troglodytes | WC |
| Papio_anubis | WC |
| Piliocolobus_tephrosceles | WC |
| Pongo_abelii | WC |
| Pongo_pygmaeus | WC |
| Saimiri_boliviensis | WC |
| Sapajus_apella | WC |
| Symphalangus_syndactylus | WC |
| Theropithecus_gelada | -- |
| Trachypithecus_francoisi | WC |


Macaca mulatta
Piliocolobus tephrosceles
Macaca nemestrina
Papio anubis
Theropithecus gelada
Trachypithecus francoisi
Nomascus leucogenys
Symphalangus syndactylus
Pongo abelii
Pongo pygmaeus
Gorilla gorilla
Homo sapiens
Pan paniscus
Pan troglodytes
Aotus nancymaae
Saimiri boliviensis
Cebus imitator
Sapajus apella
Carlito syrichta
Lemur catta
Microcebus murinus
Nycticebus coucang
Otolemur garnettii
Mus musculus
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74
65
86
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A glimpse on the discussions…

# A STUDY ON GRASSHOPPER DIVERSITY IN CHRIST COLLEGE (AUTONOUMOUS), IRINJALAKUDA

**DEPARTMENT OF ZOOLOGY,**
**CHRIST COLLEGE (AUTONOMOUS),**
**IRINJALAKUDA**
**THRISSUR, KERALA-680 125**

**MARCH 2024**

# A STUDY ON GRASSHOPPER DIVERSITY IN CHRIST COLLEGE IRINJALAKUDA

***Project report submitted to the University of Calicut in partial fulfillment of the requirement for the award of the Degree***

## BACHELOR OF SCIENCE
## IN ZOOLOGY

| Sl No. | Group members | Register No. |
|---|---|---|
| 1. | AKSHAY K A | CCAVSZO002 |
| 2. | ALEENA MARIYA | CCAVSZO016 |
| 3. | ANAGHA ARUN M A | CCAVSZO004 |
| 4. | ANAGHA SAIBU | CCAVSZO018 |
| 5. | ANJIMA JOSE | CCAVSZO020 |
| 6. | MARIYA T J | CCAVSZO028 |
| 7. | NEETHU N M | CCAVSZO009 |
| 8. | RAHMA | CCAVSZO011 |
| 9 | SANDRA K SHAJU | CCAVSZO032 |

**DEPARTMENT OF ZOOLOGY**
**CHRIST COLLEGE (AUTONOMOUS) IRINJALAKUDA**
**THRISSUR, KERALA 680125**

**Examiners:**

**1.** **2.**

# DECLARATION

We, Akshay K A, Aleena Mariya, Anagha Arun M A, Anagha Saibu, Anjima Jose, Mariya T J, Neethu N M, Rahma and Sandra K Shaju, do hear by declare that this project entitled "**Study on grasshopper diversity in Christ College (Autonomous), Irinjalakuda**" is a genuine record of project work done by us under the guidance of Dr. Bijoy C., Assistant Professor, Department of Zoology, Christ College (Autonomous), Irinjalakuda, and has not been submitted to any university or Institution for the Award of any Degree or Diploma.

We further declare that results presented in this work and considerations made therein, contribute in general to the advancement of knowledge in science.

| Sl. No | Register Number | Name | Signature |
|---|---|---|---|
| 1 | CCAVSZO002 | AKSHAY K A | |
| 2 | CCAVSZO016 | ALEENA MARIYA | |
| 3 | CCAVSZO004 | ANAGHA ARUN M A | |
| 4 | CCAVSZO018 | ANAGHA SAIBU | |
| 5 | CCAVSZO020 | ANJIMA JOSE | |
| 6 | CCAVSZO028 | MARIYA T J | |
| 7 | CCAVSZO009 | NEETHU N M | |
| 8 | CCAVSZO011 | RAHMA | |
| 9 | CCAVSZO032 | SANDRA K SHAJU | |

Place: Irinjalakuda

Date:

SHADPADA
ENTOMOLOGY
RESEARCH
LAB

Christ College (Autonomous),
Irinjalakuda, Thrissur- 680 125

Dr Bijoy C.
Assistant Professor,
Research Department of Zoology,
drbijoyc@gmail.com
Mob: 9895551003

# CERTIFICATE

This is to certify that the content of this project work entitled "**STUDY ON GRASSHOPPER DIVERSITY IN CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA**" is an original work done by the following students under my supervision and guidance at the Department of Zoology, Christ College (Autonomous), Irinjalakuda. I further certify that no part of the work has been presented for the award of any other Degree or Diploma.

| Sl. No | Register Number | Group members |
|---|---|---|
| 1 | CCAVSZO002 | AKSHAY K A |
| 2 | CCAVSZO016 | ALEENA MARIYA |
| 3 | CCAVSZO004 | ANAGHA ARUN M A |
| 4 | CCAVSZO018 | ANAGHA SAIBU |
| 5 | CCAVSZO020 | ANJIMA JOSE |
| 6 | CCAVSZO028 | MARIYA T J |
| 7 | CCAVSZO009 | NEETHU N M |
| 8 | CCAVSZO011 | RAHMA |
| 9 | CCAVSZO032 | SANDRA K SHAJU |

**Place:** Irinjalakuda

**Date:**

**Dr. Bijoy C.**

Project Supervisor

## CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA

## DEPARTMENT OF ZOOLOGY

# CERTIFICATE

This is to certify that the project work entitled **'A study on grasshopper diversity in Christ College (Autonomous) Irinjalakuda'** is an authentic record of research work carried out by **Akshay K A, Aleena Mariya, Anagha Arun M A, Anagha Saibu, Anjima Jose, Mariya T J, Neethu N M, Rahma** and **Sandra K Shaju** as a part of B.Sc. practical during the year 2022- 2023 and the results of this work has not been presented for the award of any other degree/diploma in any university.

Place: Irinjalakuda

Date:

**Dr. Sudhikumar A. V.**

Head, Department of Zoology,

Christ College, Irinjalakuda

## ACKNOWLEDGMENTS

The success and final outcome of this project required a lot of guidance and assistance from people. Whatever we have done is only due to such guidance and assistance and we would like to express our gratitude to the following individuals without whom the work would not have been completed.

Firstly, we would like to express our heartfelt gratitude to the Almighty for providing us with the strength, wisdom, and perseverance throughout the course of this project.

We would like to express our sincere gratitude to Dr Bijoy C, Assistant Professor, Department of Zoology, Christ College, Irinjalakuda, for providing necessary advice, for his patience in bearing our ideas, and for all the efforts he made to see this project through to completion. This study would not be possible without his tremendous help and guidance. His dedication to academic excellence has been truly inspiring.

We are deeply indebted to Dr A.V. Sudhikumar, Head of Department of zoology, Christ College, Irinjalakuda, as well as all other teaching and non-teaching department personnel, for the suggestions.

We are also grateful to Rev. Dr Jolly Andrews CMI, Principal of Christ College Irinjalakuda, for providing all available resources for this project and for fostering an environment of learning and excellence at college.

We are immensely grateful to Ms. Thasnim E S, Research scholar at Shadpada Entomology Research Lab (SERL), Christ College, Irinjalakuda, for the identification of specimens, providing necessary ideas from the start of this project and for her valuable insights, and contributions to this project. Her dedication and expertise have been invaluable assets throughout the process.

Lastly, we extend our heartfelt thanks to our family for their encouragement, and support during the field trips.

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## ABSTRACT

The present study is an attempt to find the diversity of grasshoppers in Christ College campus, to calculate the relative abundance of collected grasshoppers and to study their variations according to seasons and habitats. The study was carried out in four sites of Christ College campus, Irinjalakuda, Thrissur district, Kerala. Collection was done on two different seasonal period from monsoon to post monsoon. Post monsoon has the maximum species richness and monsoon shows more species diversity. According to our study, we observed 19 grasshopper species, Family Acrididae is the most abundant and Family Tetrigidae has the least abundance.

# A Bioinformatic Study on the Molecular Evolution of Collagenases in Primates

*A project report submitted to the* ***University of Calicut*** *in partial fulfilment of the requirement for the award of the Degree*

## BACHELOR OF SCIENCE IN ZOOLOGY

BY


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DEPARTMENT OF ZOOLOGY

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**MARCH 2024**

# CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA
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## CERTIFICATE

This is to certify that the project work entitled **'A Bioinformatic Study on the Molecular Evolution of Collagenases in Primates'** is an authentic record of research work carried out by **Chandana Janardhanan, Lakshmi AP, Niharika, Salvador VS, Abhinav Krishna PV, Aysha Nedha Sakir, Mithralmajan PT, Anjima NC** and **Grace Maria Paulson** as part of BSc syllabus during the year **2023-2024** and the results of this work has not been presented for the award of any other degree/ diploma in any university.

### Certified bona fide by

**Dr. Leyon Varghese**
Supervising Guide

**Dr Sudhikumar A. V.**
Head, Department of Zoology

Date :

Place :

### Examined by

1. ____________________________

2. ____________________________

# DECLARATION

We, the following students do hereby declare that this project report entitled **'A Bioinformatic Study on the Molecular Evolution of Collagenases in Primates'** is a genuine record of the project work done by us under the guidance of Dr. Leyon Varghese, Assistant Professor, Department of Zoology, Christ College (Autonomous), Irinjalakuda and that this report has not been submitted to any University/Institution for the award of any Degree or Diploma. We further declare that the results presented in this work and considerations made therein, contribute in general to the advancement of knowledge in science and is devoid of any plagiarism.

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Place : Irinjalakuda

Date : 28-02-2024

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## INTRODUCTION

The first true primates evolved around 55 million years ago or a bit earlier, near the beginning of the Eocene Epoch. Their fossils have been found in North America, Europe, and Asia. They looked different from the present day primates. Changes in gene regulation and differences in mRNA expression levels across primates have often been documented, however, it is not yet known to what extent measurements of divergence in mRNA levels reflect divergence in protein expression levels, which are probably more important in determining phenotypic differences. Collagenases, a subgroup of Matrix matalloproteases (MMPs) are a large family of zinc-dependent endopeptidases with a great affinity for several components of the extracellular matrix. The collagenases include MMP-1 (interstitial collagenase/collagenase-1), MMP-8 (neutrophil collagenase/collagenase-2), and MMP-13 (collagenase-3). These MMPs attack triple helical regions of interstitial collagen types I, II, and III at a specific single site after the Gly residue of the partial sequences Gly-(Ile or Leu)-(Ala or Leu), located about three-fourths of the distance from the N-terminus. This cleavage generates fragments approximately three-fourths and one-fourth of the size of the collagen molecules. They are distinct from a closely related gelatinases (MMP2 and 9) that are characterized by the presence of the additional fibronectin domain located inside the catalytic domain.

A phylogenetic tree or evolutionary tree is a graphical representation which shows the evolutionary history between a set of species or taxa during a specific time. In other words, it is a branching diagram or a tree showing the evolutionary relationships among various biological species or other entities based upon similarities and differences in their physical or genetic characteristics. In evolutionary biology, all life on Earth is theoretically part of a single phylogenetic tree, indicating common ancestry. Phylogenetics is indeed the study of this phylogenetic tree. The main challenge is to find a phylogenetic tree representing optimal evolutionary ancestry between a set of species or taxa. The first step in the phylogenetic tree construction (using bioinformatics tool) with a new sequence would be to use BLAST. This nifty yet powerful resource matches your sequence to the millions of sequences stored in genomic and nucleotide databases. The tool comes up with the sequences most similar to the query submitted.

It also gives insights as to the possible identity of those sequences. The results include homologues across species and in similar tissues or organisms. A sequence alignment is a way of arranging the sequences of DNA, RNA, or protein to identify regions of similarity that may be a consequence of functional, structural, or evolutionary relationships between the sequences. If two sequences in an alignment, they share a common ancestor and mismatches can be interpreted as point mutations and gaps as indels (that is, insertion or deletion mutations) introduced in one or both lineages in the time since they diverged from one another. In sequence alignments of proteins, the degree of similarity between amino acids occupying a particular position in the sequence can be interpreted as a rough measure of how conserved a particular region or sequence motif is among lineages.

Phylogenetics and sequence alignment are closely related fields due to the shared necessity of evaluating sequence relatedness. The field of phylogenetics makes extensive use of sequence alignments in the construction and interpretation of phylogenetic trees, which are used to classify the evolutionary relationships between homologous genes represented in the genomes of divergent species. The degree to which sequences in a query set differ is qualitatively related to the sequences evolutionary distance from one another. Roughly, high sequence identity suggests that the sequences in question have a comparatively young most recent common ancestor, while low identity suggests that the divergence is more ancient. This approximation, which reflects the “molecular clock” hypothesis that a roughly constant rate of evolutionary change can be used to extrapolate the elapsed time since two genes first diverged , assumes that the effects of mutation and selection are constant across sequence lineages.

**REVIEW OF LITERATURE**

Primates are unique among placental mammals. Two extreme type of placentation are present in this single order. Strepsirrhines have non-invasive epitheliochorial placentation and Haplorhines have highly invasive haemochorial placentation. Strepsirrhines include Lemurs and Lorisiforms and Haplorhines include tarsiers and higher primates. Resemblance in placenta type provide the first evidence that tarsiers are linked to higher primates and distinct from lemurs and lorisiforms. Tree-shrews have endotheliochorial placentation and differ from both primate subgroups. Endotheliochorial placentation is primitive and epitheliochorial placentation is unlikely to be primitive.The recent availability of comprehensive molecular phylogenies for placental mammals has provided an independent framework to determine the most parsimonious interpretation of the evolution of placenta types (Robert Martin, 2008). In an earlier elaborate study, speciation between primates and rodents was estimated by looking at the protein coding genes of mitochondrial genomes from 31 mammals (A.D Yoder 2000). Based on paleontological data, three calibration points were used: one at 20–25 MYA for the hominoid/cercopithecoid divergence, one at 53–57 MYA for the cetacean/artiodactyl divergence, and the third at 110–130 MYA for the metatherian/eutherian divergence.  Nulceotide and the amino acid sequence were looked at and results produced that were not mutually exclusive.

Even with decades of data and methods, we still can't agree on the exact evolutionary tree of higher primates (apes and humans). The most likely scenario has humans closest to chimps, but other possibilities exist. Despite numerous theories, 20 key reasons cause this uncertainty. New methods using DNA offer hope for more definitive answers. (Holmquist et al 1988). Primate phylogeny forms a solid framework for a novel depiction of diverse patterns of genome evolution among primate lineages. They are essential for future comparative genomic investigation of adaptation and selection in humans and across primates. Studies on the evolution of catarrhine primates were done using molecular, fossil and bio geographical data. It was found that the common ancestor of Old World Monkeys originated in Africa and some monkeys later moved to Asia around 10 million years ago. The study further suggested that the ancestor of the

living homininds left Africa about 20 mya and the common ancestor of the living African apes returned to Africa from Eurasia around 10 mya (Caro-Beth Stewart, Todd R Disotell 1998).

In the deep study of evolutionary roots of strepsirrhine primate labyrinthine morphology, geometric morphometric analysis showed that the labyrinthine morphology of extant strepsirrhines contains a mixed locomotor, allometric and phylogenetic signal. Discriminant analysis at the family level confirmed that labyrinthine shape is a good taxonomic marker. The results support the hypothesis that evolutionary change in labyrinthine morphology is adequately described with a random walk model, i.e. random phenotypic dispersal in morphospace (Lebrun et al, 2010). An overview of the taxonomy of New World primates based on morphology to the great number of studies based on molecular data aiming for the elucidation of the phylogeny of New World monkeys. The traditional classification of the infraorder Platyrrhini divided these primates into Cebidae and the Callitrichidae, with Callimico being allocated to either the former (Simons, 1972, Simpson, 1945) or the latter family. Hill (1957) and Hershkovitz, 1972, Hershkovitz, 1977 proposed a third family – Callimiconidae – to accommodate Callimico, because it shares characteristics that define both cebids and callitrichids. According to Hershkovitz (1977), then all New World primates should be included in one of three families – the Callitrichidae which comprised the marmosets, tamarins (Saguinus) and lion tamarins (Leontopithecus), the monotypic Callimiconidae (Callimico) and the Cebidae (Schneider et al, 2015).

In a study on molecular phylogeny and evolution of primate mitochondrial DNA, researchers determined nucleotide sequences of homologous 0.9-kb fragments of mitochondrial DNAs (mtDNAs) derived from four species of old-world monkeys, one species of new-world monkeys, and two species of prosimians. With these nucleotide sequences and homologous sequences for five species of hominoids, they constructed a phylogenetic tree for the four groups of primates. The phylogeny obtained is generally consistent with evolutionary trees constructed in previous studies. The results also suggest that the rate of nucleotide substitution for mtDNAs in hominines (human, chimpanzee, and gorilla) have slowed down compared with that for old-world monkeys (Hayasaka, 1988). Mitochondrial genomes have been used to study the

phylogenetic relationship of primates in detail. Using 454 sequencing, the study adds 32 new complete mitochondrial genomes and introduces 20 previously unrepresented genera in the primate tree. The study focuses on the New world monkeys and suborder Strepsirrhini. (Knut Finstermeier, et al 2013). The evolutionary relationships of the number of species within the genus Lepilemur were analysed with the help of a comparative cytogenetic and molecular study. The study involved the complete sequencing of the mitochondrial cytochrome b gene from 68 individuals and the results were compared to those obtained from cytogenetic studies derived from 99 specimens. The results support the classification of the eight major supportive lemur taxa as independent species. (Nicole Andriaholinirina, et al. 2006)

The relationship between the prion protiens and new world primate phylogeny have been studied. The PrP C prion protein contains 250 amino acids with some variation among species and is expressed in several cell types. Variations in the prion protein gene were observed among 16 genera of New World primates (Platyrrhini), and resulted in amino acid substitutions when compared with the human sequence. Schneider et al, 2004)

Beta-globin gene cluster of primates were analyzed to understand their evolutionary history. The rate of accumulation of mutations have also been seen to vary by a factor of 7 among different primate lineages. The study groups superfamilies Lemuroidea and Lorisoidea into suborder Strepsirhini and Tarsius and Anthropoidea into suborder Haplorhini. Evolution rates have been suggested to have slowed down over the past 25 million years of hominoid descent and has found to have happened in correlation with lengthened lifespans (Koop, BF et al 1989).

Using the SINE's methods for the analysis of mobile element based of old world monkeys. It helps to known ancestral staples. Makes them to useful genetic studies for phylogenetic studies. Alu is an helping part of it, in this methods found 285 new Alu Insertions from sixteen old world monkeys. Old world monkeys are  represent on the most diverse and largest primate families. And have  respect classification. The phylogenetic researchers are classified and grouped the old world monkeys into different classes and divisions. Mainly the subfamily  cerocopithecidae  are the most studied group.. SINEs ( short interspersed element are

used  as the genetic markers this  will helps to analysis several levels of phylogenetic analysis. Using both Compcompuational and PCR methods (Xing a et al, 2005).

New world monkeys represent monophyletic group. The phylogenetic relationships among new world monkeys have been extensively investigated using nucleotide sequence from different genome.In these studies still there are some unresolved issues.There are three monophyletic new world monkey families Atelidae, Cebidae and Pitheciidae. As a result Maximum parsimony analysis support the three proposed platyrrhine families. In the maximum parsimony tree, the two most closely related families are Atelidae and Cebidae.Phylogenetic relationships were reconstructed by maximum parsimony, maximum likelihood, and Bayesian approaches (JuanC Opazo et al, 2006). Anthropoid primates from the neotropics are members of parvorder Platyrrhini. The platyrrhines are also called New World monkeys. There are more than 125 species of extant New World monkeys  found in approximately 15 genera. The phylogenetic relationships of these neotropical primates have been extensively studied from a molecular perspective (Derek wildman et al, 2009).

Phylogenetic trees are certainly useful for comparative studies, providing a useful framework for comparative biologists. Species evolution is not statistically independent. The fact that close relatives inherit characteristics from their common ancestor has always complicated the analysis of cross- species data. The methods in turn developed to resolve such issues, all requires resolved phylogeny. In one of the earlier studies, primates phylogeny was estimated of all 203 species of primates. Application of parsimony algorithm and bootstrapping resulted in the composite tree with 160 nodes (Purvis, Andy 1995).

In a project conducted under the support from National Cancer Institute and National Institute of Health, researchers constructed a robust phylogenetic tree of primates. The tree was constructed from the data collected of genomic sequences from 186 primates. Also outgroup species from Dermoptera, Scandentia and Lagomorpha was included. This phylogenetic representation done carefully was a notable illumination showing the pathway of primates evolution (Perelman et.al 2011).

Studies also estimated the molecular divergence dates of major primates in the context of molecular clock studies. Such studies also aid in understanding the lineage. Utilizing the genomic data, molecular divergence dates were able to be studied since alignments can be arranged and sites can be analysed for this study. Much before the molecular clock, paleontology used to provide only a mere timeframe of species evolution (Steiper et.al. 2006).

Inferring molecular phylogeny for evolutionary studies are done in non- primates as well. The molecular phylogeny of malarial parasites was recovered from mitochondrial cytochrome b gene sequences. Parsimony as well as maximum- likelihood analysis produced similar phylogenetic trees in this case. The conclusions were supported by hypothesis testing (Perkins et.al 2002). Inferring species super matrix has helped in studying macroevolutionary dynamics and even historical biogeography. The results obtained highlighted both the power as well as limitations of inferring the molecular phylogeny data to different species concepts (Springer et.al. 2012).

Over the past 60 million years, a million copies of Alu DNA have appeared in the genomes of primates. This is still an ongoing process. DNA alu repeats in the genomes of primates such as human, chimpanzee, gorilla, orangutan, baboon, rhesus, and macaque. New Alu elements arise in unique and irreversible events and appear to prevent precise excision and loss. The same insertions cannot occur independently in two species. Once the insert is genetically fixed, the DNA elements persist in all descendant lineages. Different from point mutation, the distribution of individual alu corresponds to a phylogeny only (H. Hamdi, 1999).

To resolve the debate in strepsirrhine phylogeny, 61 loci containing interspersed elements were characterized and the absence and presence of orthologous loci in the strepsirrhine panel was determined. According to these findings, it is concluded that strepsirrhines originated in Africa, and that Madagascar and Asia were colonized by immigration events (C. Roos, 2004). To investigate the phylogenetic relationships among species of New World monkeys, 1.3 kb of DNA was collected for 2 introns of the glucose-6-phosphate dehydrogenase locus encoded on the x chromosome of 24 species of New World monkeys (M. Von. Dornum, 1999).

Two molecular based approaches are used to date the initial divergence of the platyrrhine clade, a relaxed clock model using fossil record and genome datasets, and Bayesian inferences from generation time and body size to substitution rate. Fossil constraints, topology, and substitution rate are an important part of our divergence time estimates.  making an impact. Bayesian estimates using conservative and realistic fossil constraints suggest that the LCA of extant platyrrhines is 29 Ma, with a 95% confidence interval for Nodine of 27–31 Ma (SI Perez, 2013). The sequences of nuclear protein-coding gene LCAT were used to study the relationship between 19 extant rodents. The study agrees with several previous molecular and morphological studies, both concerning branching orders inside Muroidea and the bush-like radiation of rodent suprafamilial taxa. This indicates that this nuclear gene is a fitting candidate for tackling questions about rodents relationships.

The data from primates were used to reveal that the molecular clock in CpG and non-CpG sites have different nature, projecting differences in their molecular origin. Through the process, it was observed that molecular clocks are heterogeneous even within a genome. During phylogenetic analysis and while concluding divergence times using molecular data, one should be mindful that different regions of genome follow different  molecular clocks. In this study, our efforts are directed towards studying the pathway of certain collagenases in the course of evolution. Even though  some studies have been done using DNA sequences and that too in different context, in our study we focusses primarily on amino acid sequences. This is not a well researched area. Though this study we aim on providing a new work in the area of comparative biology. The results of the work may be useful in the future providing insights into how may be the few crucial changes in amino acids may have resulted into a complete new lineage.

## SIGNIFICANCE OF THE STUDY

The study of molecular evolution in primates through the comparison of amino acid sequences using bioinformatics tools represents a novel and underexplored area of research. To date, there has been a notable scarcity of studies employing bioinformatics techniques to investigate the evolutionary patterns of primates, particularly in relation to proteins such as MMP1, MMP8 and MMP13 collagenases. The selection of these collagenases for our study is particularly significant due to their split genes nature. By conducting a comparative analysis of the evolutionary trees derived from the collagenases with established standard trees, we aimed to shed light on the distinctive evolutionary trajectories of these proteins in primates. The insights obtained from this comparative study have the potential to deepen our understanding of the molecular evolution of primates and elucidate the factors driving the evolution of collagenases in this taxonomic group.

**OBJECTIVES**

1. Retrieval of relevant data (Gene/mRNA/protein sequence of collagenases of primates) from relevant reliable resources such as NIH or SIB.

2. Align the retrieved sequences using bioinformatics software to ensure they are in the correct reading frame and homologous positions are appropriately aligned.

3. Construction of the phylogenetic trees based on the Gene/mRNA/protein sequence of collagenases in primates.

## METHODOLOGY

The three human collagenases used in the study are MMP1, MMP8 and MMP13. The FASTA sequence and other details of collagenases are as below.

```
>NP_002412.1 interstitial collagenase isoform 1 MMP1 UniProt_P03956 [Homo sapiens]
MHSFPPLLLLLFWGVVSHSFPATLETQEQDVDLVQKYLEKYYNLKNDGRQVEKRRNSGPVVEKLKQMQEF
FGLKVTGKPDAETLKVMKQPRCGVPDVAQFVLTEGNPRWEQTHLTYRIENYTPDLPRADVDHAIEKAFQL
WSNVTPLTFTKVSEGQADIMISFVRGDHRDNSPFDGPGGNLAHAFQPGPGIGGDAHFDEDERWTNNFREY
NLHRVAAHELGHSLGLSHSTDIGALMYPSYTFSGDVQLAQDDIDGIQAIYGRSQNPVQPIGPQTPKACDS
KLTFDAITTIRGEVMFFKDRFYMRTNPFYPEVELNFISVFWPQLPNGLEAAYEFADRDEVRFFKGNKYWA
VQGQNVLHGYPKDIYSSFGFPRTVKHIDAALSEENTGKTYFFVANKYWRYDEYKRSMDPGYPKMIAHDFP
GIGHKVDAVFMKDGFFYFFHGTRQYKFDPKTKRILTLQKANSWFNCRKN

>NP_002415.1 neutrophil collagenase isoform 1 MMP8 UniProt_P22894 [Homo sapiens]
MFSLKTLPFLLLLHVQISKAFPVSSKEKNTKTVQDYLEKFYQLPSNQYQSTRKNGTNVIVEKLKEMQRFF
GLNVTGKPNEETLDMMKKPRCGVPDSGGFMLTPGNPKWERTNLTYRIRNYTPQLSEAEVERAIKDAFELW
SVASPLIFTRISQGEADINIAFYQRDHGDNSPFDGPNGILAHAFQPGQGIGGDAHFDAEETWTNTSANYN
LFLVAAHEFGHSLGLAHSSDPGALMYPNYAFRETSNYSLPQDDIDGIQAIYGLSSNPIQPTGPSTPKPCD
PSLTFDAITTLRGEILFFKDRYFWRRHPQLQRVEMNFISLFWPSLPTGIQAAYEDFDRDLIFLFKGNQYW
ALSGYDILQGYPKDISNYGFPSSVQAIDAAVFYRSKTYFFVNDQFWRYDNQRQFMEPGYPKSISGAFPGI
ESKVDAVFQQEHFFHVFSGPRYYAFDLIAQRVTRVARGNKWLNCRYG

>NP_002418.1 collagenase 3 MMP13 UniProt_P45452 [Homo sapiens]
MHPGVLAAFLFLSWTHCRALPLPSGGDEDDLSEEDLQFAERYLRSYYHPTNLAGILKENAASSMTERLRE
MQSFFGLEVTGKLDDNTLDVMKKPRCGVPDVGEYNVFPRTLKWSKMNLTYRIVNYTPDMTHSEVEKAFKK
AFKVWSDVTPLNFTRLHDGIADIMISFGIKEHGDFYPFDGPSGLLAHAFPPGPNYGGDAHFDDDETWTSS
SKGYNLFLVAAHEFGHSLGLDHSKDPGALMFPIYTYTGKSHFMLPDDDVQGIQSLYGPGDEDPNPKHPKT
PDKCDPSLSLDAITSLRGETMIFKDRFFWRLHPQQVDAELFLTKSFWPELPNRIDAAYEHPSHDLIFIFR
GRKFWALNGYDILEGYPKKISELGLPKEVKKISAAVHFEDTGKTLLFSGNQVWRYDDTNHIMDKDYPRLI
EEDFPGIGDKVDAVYEKNGYIYFFNGPIQFEYSIWSNRIVRVMPANSILWC
```

The study on phylogenetic relationships in primates was conducted using this amino acid sequences to do the BLAST (Basic Local Alignment Search Tool) analysis in the NCBI Genebank database. The most suitable amino acid sequences for each primate species were then carefully selected from sequences delivered by the server. An out group was chosen which in our study was the Mus musculus of the order Rodentia.

The selected sequences were then compared with that of the out group and a phylogenetic tree was constructed based on the degree of divergence. The software used for constructing phylogenetic tree was  Molecular Evolutionary Genetics Analysis (MEGA).

## RESULTS AND DISCUSSIONS

The research article titled "A Molecular Phylogeny of Living Primates" published in 2011, established a robust and widely accepted framework for understanding primate evolution. This phylogenetic tree served as a standard reference for our study, allowing us to compare our data and draw conclusions. According to this article Order Primata is subdivided into two major Suborder Haplorrhini and Strepsirrhini. The remaining primate phylogeny is classified as follows.

**Suborder Haplorrhini** further divides into Infraorders, namely Simiiformes and Tarsiiformes. Tarsiiforme include only one Family (Tarsiidae) with only two extant species. Simiiformes is subdivided into Parvorders Catarrhini (Old world) and Platyrrhini (New world).

Parvorder Catarrhini in turn consist of the Superfamilies Cercopithecoidea and Hominoidea. Cercopithecoidea has only one extant Family *viz*. Cercopithecidae but the organisms of Superfamily Hominoidea is further divided into two Families, *viz*, Hylobatidae and Hominidae. Family Cercopithecidae has two Subfamilies such as Cercopithecinae and Colobinae. Family Hylobatidae include all Gibbon Genus and there is no further subgrouping. Hominidae on the other hand has two Subfamilies *viz.* Homininae and Ponginae. Subfamily Ponginae include all species of Orangutang and all o there Greater Apes and Humans are included in Homininae. Subfamily Cercopithecinae is subdivided into two Tribes namely, Papionini and Cercopithecini whereas Colobinae is subdivided into two Tribes namely Presbytini and Colobini.

Parvorders Platyrrhini on the other hand is divided directly into three Families such as Cebidae, Atelidae and Pitheciidae. Family Cebidae has four Subfamilies namely, Callitrichinae, Aotinae, Cebinae and Saimirinae. Fly. Atelidae has two Subfamilies (Atelinae & Alouattinae) so also Fly. Pitheciidae (Callicebinae & Pitheciinae).

**Suborder Strepsirrhini** is divided into the Infraorders Lemuriformes, Chiromyiformes and Lorisiformes. Unlike Haplorrhini, there is no observed grouping of these Infraorders into Parvorders or Superfamilies. Instead, they are grouped into Families such as Lepilemuride,

Cheirogaleidae, Indriidae, Lemuridae, Daubentoniidae, Lorisidae and Galagidae. Further subdivision within Lorisidae includes the subfamilies Lorisinae and Perodicticinae.

**MMP-1**

The phylogenetic tree for the MMP1 gene in primates was meticulously constructed, employing an analysis of amino acid sequences from various primate species. To enhance our phylogenetic analysis, *Mus musculus* was strategically employed as the outgroup, providing a reference point for the evolutionary relationships within the MMP1 collagenase gene among primates. Our investigation also utilized a well established standard phylogenetic tree for primates, derived from genomic sequences across diverse species, serving as a foundational reference for elucidating the evolutionary dynamics of collagenase genes within our study group (Reference). The results obtained regarding the evolutionary pathway of the MMP1 gene include the following observations:

- *Carlito syrichta*: Our findings indicate that MMP1 gene of *Carlito syrichta,* a tarsier species primarily descended with minimal changes from the common ancestor of all primates indicating an ancient ancestry. Although this tree suggests such an ancient ancestry and early divergence of *Carlito syrichta* from the early primate stock, a comparison with the established tree reveals that tarsiers diverged from a common stock of strepsirrhini - more primitive primate. It is therefore inferred that the MMP1 gene remained with minimum changes in the tarsiers as compared to strepsirrhini primates.

- *Hominidae:* In our tree constructed using MMP1 the common ancestor of *Pan* and *Homo*, along with the common ancestor of *Gorilla* and *Pongo,* collectively share a common ancestor. Gibbons, including *Nomascus* and *Symphalangus,* share a common ancestor that along with the common ancestor of *Hominidae* were descended from a common stock of interbreeding ape like animal. Upon analysing the standard phylogenetic tree, a similar pattern emerges, with *Homo* and *Pan* sharing a common ancestor. This common ancestor was also ancestral to present day *Gorilla,* from which the *Pongo* ancestry might have diverged. However, the discrepancy in our results suggestive of *Gorilla* sharing a recent

common ancestor with *Pongo,* but not with *Homo* or *Pan*. This suggests a simultaneous origin for *Gorilla* and *Pongo*, contrary to the standard tree's assertion of *Gorilla*'s more recent evolution compared to *Pongo*. Further analysis of the amino acid sequences are required to see if the *Homo-Pan* group has any common advantage with the kind of changes on the MMP1 protein over the *Gorilla-Pongo* group.

- Old World Monkeys: Our results indicate that, three groups *viz. Macaca*, *Papio* and *Theropithecus* are equally distant from a common ancestor, while *Colobus* and *Trachypithecus* share another common ancestor. The standard phylogenetic tree confirms this, revealing a common ancestor for *Colobus* and *Trachypithecus,* along with the ancestor of *Macaca, Papio* and *Theropithecus.* But with *Macaca, Papio* and *Theropithecus,* our results differ from the standard tree. While standard tree implies that *Papio* and *Theropithecus* had a common ancestor after the common ancestry shared with *Macaca,* our tree do not mention between an ancestor common to both *Papio* and *Theropithecus.* Though the changes are minimal, it wold be interesting to look for the their sequences for further analysis.

- New World Monkeys: Our findings in New World Monkeys suggest that *Saimiri* and *Cebus* share a most recent common ancestor, while *Aotus* share a common ancestor with this lineage. This is consistent with both our phylogenetic tree and the standards phylogenetic tree. Furthermore, *Nycticebus* and *Otolemur* share a common ancestor, and *Lemur* and *Microcebus* also share a common ancestor. The common ancestors of these pairs collectively had a single common ancestor, aligning with observations on the standard phylogenetic tree.

**MMP-8**

- *Hominidae*: In the phylogenetic tree derived from MMP8 sequence data, it was observed that the common ancestor of Homo and Gorilla shares ancestry with the common ancestor of Pan. This collective ancestry is further linked to the common ancestor of Hominidae, which is shared with Gibbons. In contrast to the standard phylogenetic tree, where Pan and Homo share an ancestor ancestral to present-day Gorilla, our results suggest the potential existence of an alternative evolutionary pathway for these three species. A comprehensive investigation is recommended to explore the implications of this alternative pathway further.

- Loris: Our findings indicate that the Loris shares a common ancestor with Hominidae, Tarsier, Gibbons, New World, and Old World monkeys, all of which originate from the Strepsirrhini primates. Similarly, Lemurs are shown to arise from Haplorrhini primates. Discrepancies with the standard phylogenetic tree, which suggests a more recent common ancestry for Lemurs and Loris, necessitate further analysis to validate the proposed ancestral pattern among the descendants of these two major groups of early primates.

- New World Monkeys: Upon examining the lineage of New World monkeys, it is observed that recent descendants Aotus and Saimiri share a common ancestor, which is further linked to the common ancestor of Cebus and Sapajus. This lineage can be traced back to early Strepsirrhini primates. Although minor differences are noted compared to the standard phylogenetic tree, where an ancestor common to Saimiri and Cebus precedes the common ancestry with Aotus, further analysis is warranted to explore these nuances.

- Old World Monkeys: Our analysis reveals that Papio and Theropithecus share a common ancestor, which is connected to the common ancestor of Macaca. This ancestral lineage can be traced back to an ancestor shared with the common ancestor of Piliocolobus and Trachypithecus. The observed pattern aligns with the standard phylogenetic tree in the lineage of Old World monkeys.

**MMP-13**

- *Hominidae*: When we comparing the phylogenetic tree made by us on the basis of MMP13 and the standard one, the Nomascus leucogenys & Symphalongus syndactylus (Hylobatidae) share a recent common ancestor and they together share common ancestor with old world monkeys in MMP13. But, when we comparing this with the standard one we can observe that the Hylobatidae sharing common ancestor with Hominidae.
- New World Monkeys: Our findings in new world monkeys by comparing the Standard phylogenetic tree with the phylogenetic tree of MMP13 depicting that, in the phylogenetic tree of MMP13, the Cebus imitator & Sapajus apella shares a recent common ancestor and these group share a common ancestor with Samiri bolivensis and all of these collectively share a common ancestor with Aotus nancymaae. When we comparing this with the standard phylogenetic tree Cebus imitator & Samiri bolivensis directly arrived from a common ancestor.
- Old World Monkeys: By analysing the group Cercopithecidae in the tree of MMP13, Papio Anubis & Theropithecis gelada share a recent common ancestor and they together share a common ancestor with Macaca group, Piliocolobus tephrosceles & Trachypithecus francoisi directly. But when we comparing this with the standard phylogenetic tree, they where not sharing a common ancestor directly, all of them share a common ancestor with other species recently, but all of them primitively share a common ancestor.

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Alignment: D:\Leyon\Evolution\MMP1\1-tree_for_seaview.txt
Seaview [blocks=10 fontsize=12 A4-landscape] on Wed Jan 31 07:26:41 2024

                              1
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Mus_musculus                  MPSLP---LL LLLWAASSYS FPVFHNGDRQ NVETVWKYLE NYYNL---GK NMQAKNVNGK EMMAEKLRQM
Aotus_nancymaae               MHSYPP-LLL LLFWGVVSHG FPATLETQEQ DVEIVQKYLE QYYNLKNDGK QVEKKRSSGP --VVEKLKQM
Carlito_syrichta              MPSLP--LVL MLLWAVGSRG FPATSETREQ DVEIVQKYLE NYFNLKNDGK QFEKQRHSAP --VVEKLKEM
Cebus_imitator                MHSYPL-LLL LLFWGVVSHG FPATLETQEQ DVEIVQKYLE QYYNLKNDGK QVEKQRNSGP --VVEKLKQM
Gorilla_gorilla               MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Lemur_catta                   MPSFS--LLL LLLWGLGSHG FPAIPETQEQ DVEIVQKYLE NYYDLKNVGK QIEKKRSSGS --VVEKLKQM
Macaca_mulatta                MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDFVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Macaca_nemestrina             MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Microcebus_murinus            MPRFS--LLL LLLWSLGSHG LPVAPETQEQ DVEIVQKYLE NYYDLKNDGK QIEKKRNSGP --VVEKLKQM
Nomascus_leucogenys           MHSFPPLLLL LLFWSVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGL --VVEKLKQM
Nycticebus_coucang            MPSF---LLL LLLWGLGSHA FPAIPEPQEQ DVEIVQKYLE NYYDLKNDGS QIERKRNSGP --VVEKLKQM
Otolemur_garnettii            MSSFP--LLL LLLWGLGSHA LPVTPETQEQ DVEIVQKYLE NYYDLKNDGM QIERKRNSGP --VVEKLKQM
Pan_paniscus                  MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Pan_troglodytes               MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Papio_anubis                  MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Piliocolobus_tephrosceles     MHSFPPLLLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVQKQRNSGP --VVEKLKQM
Pongo_abelii                  MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Pongo_pygmaeus                MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Saimiri_boliviensis           MHSYPP-LLL LLFWSVVSHG FPATLETQEQ DVEIVQKYLE QYYDLKNDGK QVEKQRNSGP --VVEKLKQM
Sapajus_apella                MHSYPL-LLL LLFWGVVSHG FPATLETQEQ DVEIVQKYLE QYYNLKNDGK QVEKQRNSGP --VVEKLKQM
Symphalangus_syndactylus      MHSFPPLLLL LLFWSVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGL --VVEKLKQM
Theropithecus_gelada          MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Trachypithecus_francoisi      MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDRR QVEKQRNSGP --VVEKLKQM
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Homo_sapiens                 QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Mus_musculus                 QQLFGLKVTG NSDPETLRAM KKPRCGVPDV APYAITHNNP RWTKTHLTYS ILNYTPYLPK AVVEDAIARA
Aotus_nancymaae              QEFFGLKVTG KPDAETLNVM KQPRCGVPDV ARFVLTEGNP RWEKTHLTYR IENYTPDLPR ADVDQAIEKA
Carlito_syrichta             QKFFGLKVTG KPDPETLKVM KQPRCGVPDV AQFVLTEGNP RWQKTDLTYR IENYTPDLPK AEVDRAIEKA
Cebus_imitator               QEFFGLKVTG KPDAETLKVM KQPRCGVPDV ARFVLTEGNP RWKKTHLTYR IENYTPDLPR SDVDHAIEKA
Gorilla_gorilla              QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Lemur_catta                  QEFFGLKVTG KPDTETLKVM KQPRCGVPDV ARFVLTQGNP RWEQTHLTYR IENYTPDLPR ADVDLAIEKA
Macaca_mulatta               QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR AAVDQAIEKA
Macaca_nemestrina            QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR AAVDQAIEKG
Microcebus_murinus           QEFFGLKVTG KPDTETLKVM KQPRCGVPDV ARFVLTQGNP RWEKTHLTYR IENYTPDLSR ADVDHAIEKA
Nomascus_leucogenys          QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTAGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Nycticebus_coucang           QEFFGLKVTG TPDTETLKVM KQPRCGVPDV ARFALTPGNP RWEQTHLTYR IENYTPDLPR ADVDDAIEKA
Otolemur_garnettii           QEFFGLKVTG TPDTETLKVM KQPRCGVPDV ARFVLTQGNP RWEQTHLTYR IENYTPDLPK ADVDDAIEKA
Pan_paniscus                 QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIAKA
Pan_troglodytes              QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIAKA
Papio_anubis                 QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR AAVDQAIEKA
Piliocolobus_tephrosceles    QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDRAIEKA
Pongo_abelii                 QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Pongo_pygmaeus               QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Saimiri_boliviensis          QEFFGLKVTG KPDAETLNVM KQARCGVPDV ARFVLTEGNP RWEKTHLTYR IENYTPDLRR ADVDHAIEKA
Sapajus_apella               QEFFGLKVTG KPDAETLKVM KQPRCGVPDV ARFVLTEGNP RWEKTHLTYR IENYTPDLPR SDVDHAIEKA
Symphalangus_syndactylus     QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTAGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Theropithecus_gelada         QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR AAVDQAIEKA
Trachypithecus_francoisi     QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDRAIEKA
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Mus_musculus                  FRVWSDVTPL TFQRVFEEEG DIVLSFHRGD HGDNNPFDGP NYKLAHTFQP GPGLGGDVHY DLDETWTNSS
Aotus_nancymaae               FQLWSNVTPL TFTKVPKGQA DIMISFVRGD HQDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDETWTNNF
Carlito_syrichta              FQLWSNASPL RFTKVVEGQA DIMISFVRGD HQDNSPFYGP GENLAHAFQP GPNIGGDAHF DEDETWTNNI
Cebus_imitator                FQLWSNVTPL TFTKVPKGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GSGIGGDAHF DEDETWTNNF
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Lemur_catta                   FQLWSNASPL TFTKVFEGQA DIMISFVRGD HQDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDEQWTSDS
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Macaca_nemestrina             FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
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Pan_troglodytes               FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Papio_anubis                  FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Piliocolobus_tephrosceles     FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Pongo_abelii                  FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Pongo_pygmaeus                FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Saimiri_boliviensis           FQLWSNVTPL TFTKVPKGQA DIMISFVRGD HQDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDETWTNNF
Sapajus_apella                FQLWSNVTPL TFTKVPKGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDETWTNNF
Symphalangus_syndactylus      FKLWSDVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DDDERWTNNF
Theropithecus_gelada          FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
Trachypithecus_francoisi      FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
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Mus_musculus                     ENFNLFYVTA HELGHSLGLT HSSDIGALMF PSYTWYTEDF VLNQDDINRI QDLYGPSPNP IQPTGATTPH
Aotus_nancymaae                  REYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGKSQNP VQPTGPQTPQ
Carlito_syrichta                 QNYNLYRVAA HEFGHSLGLS HSTDIGALMY PTYT-YSGDV QLAQDDIDGI QAIYGPSQNP IQPTGPQTPQ
Cebus_imitator                   RGYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGQSPNP VQPTGPQTPQ
Gorilla_gorilla                  REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Lemur_catta                      RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYT-FSGDV QLAQDDIDGI QAIYGPSQNP NQPTGPQTPQ
Macaca_mulatta                   REYNLYRVAA HEFGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Macaca_nemestrina                REYNLYRVAA HELGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Microcebus_murinus               RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYA-FSGDV QLAQDDIDGI QAIYGPSQNP NQPIGPQTPQ
Nomascus_leucogenys              REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Nycticebus_coucang               RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYA-FSGEV ELAQDDIDGI QAIYGPSQNP IQPIGPQTPQ
Otolemur_garnettii               RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYA-FSGEV ELAQDDIDGI QAIYGPSQNP VQPTGPQTPQ
Pan_paniscus                     REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGHSQNP VQPIGPQTPK
Pan_troglodytes                  REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Papio_anubis                     REYNLYRVAA HELGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Piliocolobus_tephrosceles        REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLSQDDIDGI QAIYGGSQNP VQPTGPQTPK
Pongo_abelii                     REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGPSQNP VQPIGPQTPK
Pongo_pygmaeus                   REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGPSQNP VQPIGPQTPK
Saimiri_boliviensis              REYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGPSPNP VQPTGPQTPQ
Sapajus_apella                   REYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGQSPNP VQPTGPQTPQ
Symphalangus_syndactylus         REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Theropithecus_gelada             REYNLYRVAA HELGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Trachypithecus_francoisi         REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
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                              281
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Mus_musculus                  PCNGDLTFDA ITTFRGEVFF FKGRFYIRVN RFMPEPELNL IGILWPNLPV KLDAAYEASM IDQVRYFKGS
Aotus_nancymaae               VCDSKLTFDA ITTIRGEVFF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Carlito_syrichta              ACDSKISFDA VTTIRGEVMF FKDRFFMRTH PSYPEADLNF ISDFWPLLPN GLEAAYEDAG RDQVRFFKGY
Cebus_imitator                VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PYYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Gorilla_gorilla               VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLQAAYEFAD RDEVRFFKGN
Lemur_catta                   VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPS GLEAAYEVAS RDEVRFFKGN
Macaca_mulatta                VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Macaca_nemestrina             VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Microcebus_murinus            VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF VSVFWPQLPT GLEAAYEVAD RDEVRFFKGN
Nomascus_leucogenys           VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Nycticebus_coucang            VCDSKLTFDA VTTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPS GLEAAYEVVD RDEIRFFKGN
Otolemur_garnettii            VCDSKLTFDA VTTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEVAD RDEVRFFKGN
Pan_paniscus                  VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PSYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Pan_troglodytes               VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Papio_anubis                  VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Piliocolobus_tephrosceles     VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLQAAYEFAE RDEVRFFKGN
Pongo_abelii                  VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Pongo_pygmaeus                VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Saimiri_boliviensis           VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Sapajus_apella                VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PYYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Symphalangus_syndactylus      VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGK
Theropithecus_gelada          VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Trachypithecus_francoisi      VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLQAAYEFAD RDEVRFFKGN
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| | 351 | | | | | | |
|---|---|---|---|---|---|---|---|
| Homo_sapiens | KYWAVQGQNV | LHGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVANK | YWRYDEYKRS | MDPGYPKMIA |
| Mus_musculus | KVWAVQEQSV | LRGFPRDIHS | FFGFPSNVTH | IDAAVCEEET | GKTYFFVDHM | YWRYDENTQS | MDPGYPRLTA |
| Aotus_nancymaae | KYWAAQGQNV | LHGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVGNK | YWRYDEYKRS | MDAGYPKMIA |
| Carlito_syrichta | RFWAVQGQDV | LRGYPQDIYS | SYGFPRTVKH | IDAAVFEEET | GKTFFFVGNK | YWRYDEYKRS | MDVGYPKMIA |
| Cebus_imitator | KYWAVQGQNV | LYGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVGNK | YWRYDEYKRS | MDAGYPKKIA |
| Gorilla_gorilla | KYWAVQGQNM | LHGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVGNK | YWRYDEYKRS | MDPGYPKMIA |
| Lemur_catta | KYWAVQGQNV | LPGYPKDIYR | SFGFPRTVKH | IDAAISEEDT | GKTYFFVANK | YWRYDEYKQS | MDTGYPKKLA |
| Macaca_mulatta | KYWAVQGQNV | LPGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVANK | YWRYDEYKRS | MDPGYPKMIA |
| Macaca_nemestrina | KYWAVQGQNV | LPGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVANK | YWRYDEYKRS | MDPGYPKMIA |
| Microcebus_murinus | KYWAVQGQNV | LPGYPKDIYK | SFGFPKTVKH | IDAAVSEEDT | GKTYFFVANK | YWRYDEYKQS | MDAGYPKMIA |
| Nomascus_leucogenys | KYWAVQGQNV | LHGYPKDIYS | SFGFPRTVKR | INAALSEENT | GKTYFFVAKK | YWRYDEYKRS | MDPGYPKMIA |
| Nycticebus_coucang | KYWAVRGQDV | LHGYPKDISS | SFGFPRTVKH | VDAAVSEEET | GKTYFFVANK | YWRYDENKQS | MDTGYPKMIA |
| Otolemur_garnettii | KYWAVRGPDV | LHGYPKDISS | SFGFPRTVKH | VDAAVSEEET | GKTYFFVANK | YWRYDENKQS | MDTGYPKTIA |
| Pan_paniscus | KYWAVQGQNV | LHGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVANK | YWRYDEYKRS | MDPGYPKMIA |
| Pan_troglodytes | KYWAVQGQNV | LHGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVANK | YWRYDEYKRS | MDPGYPKMIA |
| Papio_anubis | KYWAVQGQNV | LPGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVANK | YWRYDEYKRS | MDPGYPKMIS |
| Piliocolobus_tephrosceles | KYWAVQGQNV | LRGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVANK | YWRYDEYKRS | MDPGYPKMIA |
| Pongo_abelii | KYWAVQGQNM | LHGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVANK | YWRYDEHKRS | MDPGYPKMIA |
| Pongo_pygmaeus | KYWAVQGQNV | LHGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVANK | YWRYDEYKRS | MDPGYPKMIA |
| Saimiri_boliviensis | KYWAVQGQNV | LYGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVGNK | YWRYDEYKRS | MDAGYPKMIA |
| Sapajus_apella | KYWAVQGQNV | LYGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVGNK | YWRYDEYKRS | MDAGYPKKIA |
| Symphalangus_syndactylus | KYWAVQGQNV | LHGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVAKK | YWRYDEYKRS | MDPGYPKMIA |
| Theropithecus_gelada | KYWAVQGQNV | LPGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVANK | CWRYDEYKRS | MDPGYPKMIA |
| Trachypithecus_francoisi | KYWAVQGQNV | LRGYPKDIYS | SFGFPRTVKH | IDAALSEENT | GKTYFFVANK | YWRYDEYERS | MDPGYPKMIA |

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Homo_sapiens                  HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Mus_musculus                  EDFPGIDDKV DDVFQKGENF YFFHQSVQHR FNLQIRRVDD SRDSSTWFNC ---
Aotus_nancymaae               DDFPGIGHKV DAVFMKDGFF YFFHKTRQYK FEPETKRILT LQKANSWFNC RKN
Carlito_syrichta              HGFPGIGHKV DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKN
Cebus_imitator                HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Gorilla_gorilla               HDFPGIGHKV DAVFMKDGFF YFFRGRRQYK FDPETKRILT LQKANSWFNC RKN
Lemur_catta                   LDFPGIGHKI DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKK
Macaca_mulatta                HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Macaca_nemestrina             HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Microcebus_murinus            HDFPGIGHKI DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKN
Nomascus_leucogenys           HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Nycticebus_coucang            HDFPGIGHKV DAVFKKDEFF YFFHGTRQYK FDLKTKRILT LLKANSWFNC RKH
Otolemur_garnettii            HDFPGIGHKV DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKH
Pan_paniscus                  HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Pan_troglodytes               HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Papio_anubis                  HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Piliocolobus_tephrosceles     HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Pongo_abelii                  HDFPGIGHKV DAVFTKDGFF YFFHGTRQYK FDPETKRILT LQKANSWFNC RKN
Pongo_pygmaeus                HDFPGIGHKV DAVFTKDGFF YFFHGTRQYK FDPETKRILT LQKANSWFNC RKN
Saimiri_boliviensis           HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Sapajus_apella                HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Symphalangus_syndactylus      HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Theropithecus_gelada          HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Trachypithecus_francoisi      HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
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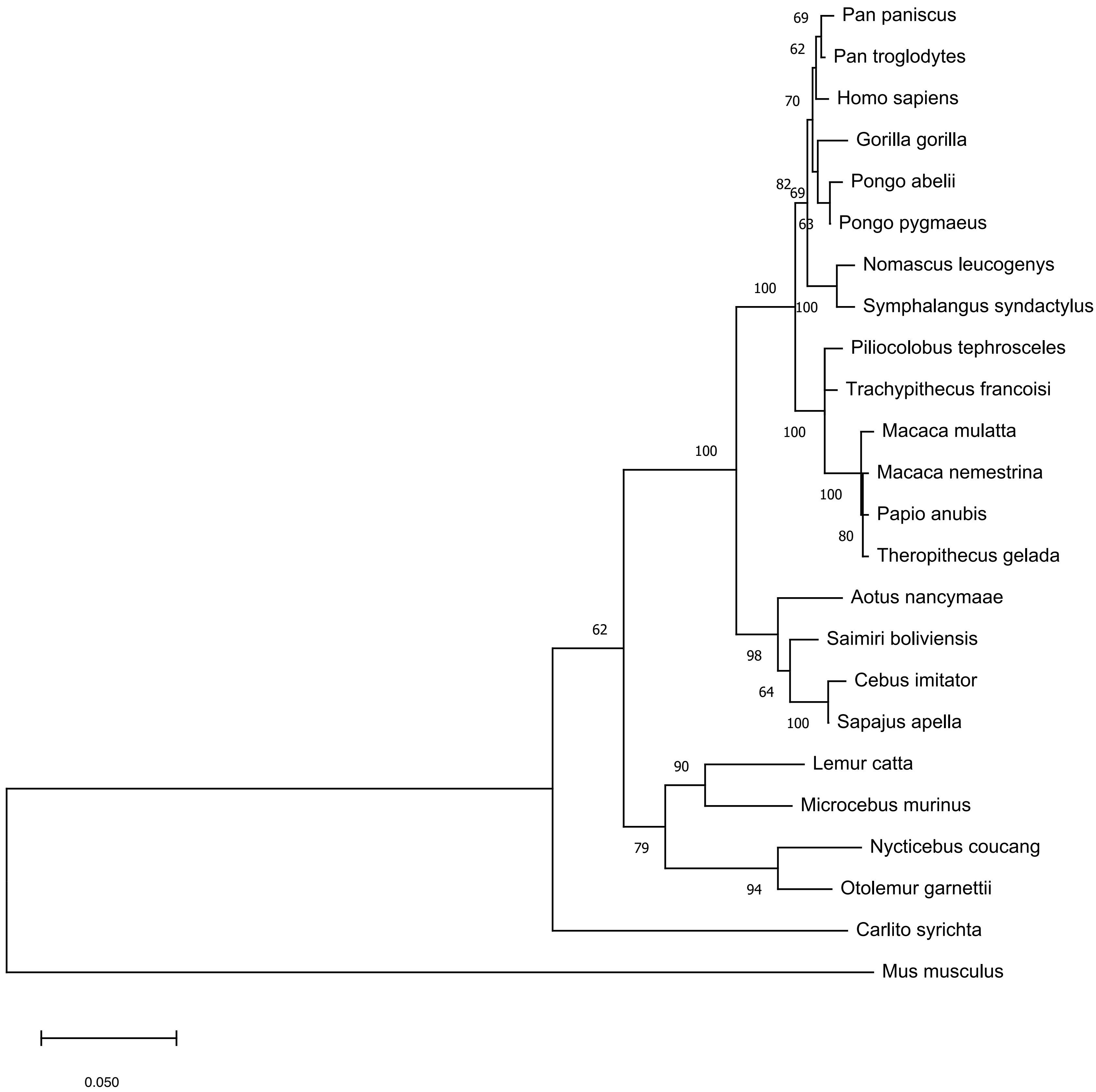
Pan paniscus
Pan troglodytes
Homo sapiens
Gorilla gorilla
Pongo abelii
Pongo pygmaeus
Nomascus leucogenys
Symphalangus syndactylus
Piliocolobus tephrosceles
Trachypithecus francoisi
Macaca mulatta
Macaca nemestrina
Papio anubis
Theropithecus gelada
Aotus nancymaae
Saimiri boliviensis
Cebus imitator
Sapajus apella
Lemur catta
Microcebus murinus
Nycticebus coucang
Otolemur garnettii
Carlito syrichta
Mus musculus
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Mus_musculus                   MFRLKTLPLL IFLHTQLANA FPVPEHLEEK NIKTAE---- -------NYLR KFYNLPSNQF RSSRN--ATM
Aotus_nancymaae                MFCLKTLPFL LLLHVQISKA FPVSS--KEK DTKIVQ---- -------DYLE KFYQLPSNQY QSIRKNSINM
Carlito_syrichta               MFSLQMLLFL LLLHMQVATA FPTPS--EEK STTMVQ---- -------DYLE KFYQLPSSRY RSARKNSTSM
Cebus_imitator                 MFCLKTLPFL LLLHVQISKA FPVSS--KEK DTKIVQ---- -------DYLE KFYQLPSNQH QSIRKNSINM
Gorilla_gorilla                MFSLKTLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Lemur_catta                    MFYLKTLPFL LLLHMELSKA FPVPS--EEK NAKIVQ---- -------DYLE KFYRLPSNQY RTARKNSPST
Macaca_mulatta                 MFSLKMLLFL LLLHVQISKA FPVSS--KEE NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTSM
Macaca_nemestrina              ---------- -------MQQ IP-------- QEKSIN---- -------DYLE KFYQLPSNQY QSTRKNGTSM
Microcebus_murinus             MFCLKTLPLL LLLHMELSKA FPVPS--EGR NAKIVQ---- -------DYLE KFYRLPSNQY RTARKNSASM
Nomascus_leucogenys            MFALKTLPFL LLLHVHISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Nycticebus_coucang             MFCLKTLLFL LLLHVQLSKT FPVVS--AEK NTKLIQ---- -------DYLE KFYQLPSNRY RTSRKNSTTM
Otolemur_garnettii             MFRLKTLVFL LLLHVPLSKT FPVVS--AEK NTKLIQ---- -------DYLE KFYQLPSNRY RTSRKNSTTM
Pan_paniscus                   MFSLKTLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Pan_troglodytes                MFSLKMLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Papio_anubis                   MFSLKMLPFL LLLHVQISKA FPVSS--KEE NTKIVQ---- -------DYLE KFYQLPSNQY QSMRKNGTSM
Piliocolobus_tephrosceles      MFSLKTLPFL FLLHVQISKA FPVSS--KEE NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTSM
Pongo_abelii                   MFSLKTLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Pongo_pygmaeus                 -MCRFPRPFL YLLKRKIQKL FSTRP--SQK PTRCSHLILD FPASKIDYLE KFYQLPSNQY QSTRKNGTNV
Saimiri_boliviensis            MFCLKRLPFL LLLHVQISKA FPVSF--KEK DTKIVQ---- -------DYLE KFYQLPSNQY QSIRKNSINM
Sapajus_apella                 MFCLKTLPFL LLLHVQISKA FPVSS--KEK DTKIVQ---- -------DYLE KFYQLPSNQY QSIRKNSINM
Symphalangus_syndactylus       MFALKTLPFL LLLHVHISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Theropithecus_gelada           MFSLKMLPFL LLLHVQISKA FPVSS--KEE NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTSM
Trachypithecus_francoisi       MFSLKTLPFL LLLHVQISKA FPLSS--KEE NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTSM
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Homo_sapiens              IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGG FMLTPGNPKW ERTNLTYRIR NYTPQLSEAE
Mus_musculus              VAEKLKEMQR FFSLAETGKL DAATMGIMEM PRCGVPDSGD FLLTPGSPKW THTNLTYRII NHTPQLSRAE
Aotus_nancymaae           IVEKLKEMQR FFGLNVTGKP NAETLEMMKQ PRCGVPDSGD FMITPGNPKW EQTNLTYRII NYTPQLSETE
Carlito_syrichta          IVEKLKEMQR FFGLNVTGKP DAETLETMEK PRCGVPDRGD FMLTPGNPKW KHTNLTYRII NYTPQLSEAD
Cebus_imitator            IVEKLKEMQQ FFGLNVTGKP NAETLEMMKQ PRCGVPDSGD FMITPGNPKW EQTNLTYRII NYTPQLSETE
Gorilla_gorilla           IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGG FMLTPGNPKW EHTNLTYRIR NYTPQLSVAE
Lemur_catta               IVEKLKEMQR FFRLNVTGKP DAETLEVMEK PRCGVPDSGD FAITPGNPKW EHTNLTYRII SYTQQLSEAD
Macaca_mulatta            IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMLTPGNPKW ERTNLTYSIL NYTPQLSETD
Macaca_nemestrina         IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMLTPGNPKW ERTNLTYSIL NYTPQLSETD
Microcebus_murinus        VVEKLKEMQR FFGLNVTGKP DAETLEVMEK PRCGVPDSSS FMITPGSPKW EHTNVTYRII SHTQQLSVAE
Nomascus_leucogenys       IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMITPGNPKW ERTNLTYRIR NYTPQLSKAD
Nycticebus_coucang        IVEKLKEMQR FFGLNVTGKP NAETLEMMEK PRCGVPDTAG FVLTPGNPKW EHINLTYRFI NYTPQLSKTD
Otolemur_garnettii        IVEKLKEMQR FFGLNVTGKP NAETLEMMEK PRCGVPDTAG FMLTPGSPKW EHTNLTYRFI NYTPQLSKTD
Pan_paniscus              IIEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGG FMLTPGNPKW ERTNLTYRIR NYTPQLSEAE
Pan_troglodytes           IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGG FMLTPGNPKW EHTNLTYRIR NYTPQLSEAE
Papio_anubis              IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMLTPGNPKW EHTNLTYRIL NYTPQLSETD
Piliocolobus_tephrosceles IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDTGD FMLTPGNPKW KHTNLTYSIL NYTPQLSQTD
Pongo_abelii              IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGE FMLTPGNPKW ERTNLTYRIR NYTPQLSEDD
Pongo_pygmaeus            IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGE FMLTPGNPKW ERTNLTYRIR NYTPQLSEDD
Saimiri_boliviensis       IVEKLKEMQR FFGLNVTGKP DAETLEMMKQ PRCGVPDSGD FMITPGNPKW EQTNLTYRFI NYTPQLSVTE
Sapajus_apella            IVEKLKEMQQ FFGLNVTGKP NAETLEMMKQ PRCGVPDSGD FMITPGNPKW EQTNLTYRII NYTPQLSETE
Symphalangus_syndactylus  IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMITPGNPKW ERTNLTYRIR NYTPQLSKTD
Theropithecus_gelada      IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMLTPGNPKW ERTNLTYRIL NYTPQLSETD
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Homo_sapiens                     VERAIKDAFE LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Mus_musculus                     VKTAIEKAFH VWSVASPLTF TEILQGEADI NIAFVSRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDS
Aotus_nancymaae                  VETAIGNAFK VWSNASSLTF TRISQGEANI SIAFFHRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDA
Carlito_syrichta                 VDSAIERAFE LWSHASPLRF TRISQGEPDI KIAFVQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Cebus_imitator                   VERAIGDAFK VWSDVSPLTF TRISQGEADI NIAFYQKDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Gorilla_gorilla                  VERAIKDAFE LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Lemur_catta                      VETAIEKAFK VWSDVSPLTF TRISRGEADI KIAFYLRDHG DNSPFDGPNG ILAHAFQPGR GIGGDVHFDA
Macaca_mulatta                   VEGAIKKAFE VWSKASPLTF TRISQGQADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Macaca_nemestrina                VEGAIKKAFE VWSKASPLTF TRISQGQADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Microcebus_murinus               VGAAFEKAFK LWSGASPLTF TRISQGEADI KIAFVQRDHG DNSPFDGPNG ILAHAFQPGP GIGGDVHFDA
Nomascus_leucogenys              VERAIEKAFK VWSDASPLTF TRISQGEADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Nycticebus_coucang               VETVIEKAFE VWSKASPLTF TKISQGEADI KIAFVRREHG DNSPFDGPNG ILAHAFQPGR GIGGDVHFDE
Otolemur_garnettii               VETVIEKAFE VWSKASPLTF TKTAQGEADI KIAFVQKDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDE
Pan_paniscus                     VERAIKDAFK LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Pan_troglodytes                  VERAIKDAFE LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Papio_anubis                     VEGAIKKAFE VWSKASPLTF TRISQGQADI NIGFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Piliocolobus_tephrosceles        VEGTIKKAFE VWSKVSPLTF TRISQGDADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Pongo_abelii                     VKTAIEKAFE VWSKASPLTF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDA
Pongo_pygmaeus                   VKTAIEKAFE VWSKASPLTF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDA
Saimiri_boliviensis              VETAIGNAFK IWSDPSPLTF TRISQGEADI NIAFFPRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Sapajus_apella                   VETAIGDAFK VWSDVSPLTF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Symphalangus_syndactylus         VERAIEKAFK VWSDASPLTF TRISQGEADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Theropithecus_gelada             VEGAIKKAFE VWSKASPLTF TRISQGQADI NIGFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Trachypithecus_francoisi         IEGAIKKAFE VWSKVSPLTF TRISQGEADI NIGFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
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Mus_musculus                EETWTQDSKN YNLFLVAAHE FGHSLGLSHS TDPGALMYPN YAYREPSTYS LPQDDINGIQ TIYGPSDNPI
Aotus_nancymaae             EETWTSTSKN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYS LPQDDINGIQ AIYGPSSNPI
Carlito_syrichta            EETWTKTSAN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYL LPQDDINGIQ AIYGPSDNPI
Cebus_imitator              EETWTNTSEN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYS LPQDDINGIQ AIYGPSSNPI
Gorilla_gorilla             EETWTNTSAS YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDIDGIQ AIYGLSSNPI
Lemur_catta                 EETWTTNANN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFREPSTYT LPQDDINGIQ AIYGPSSNPV
Macaca_mulatta              EETWTKTSTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Macaca_nemestrina           EETWTKNSTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Microcebus_murinus          EETWTTNFNN YNLFLVAAHE FGHSLGLAHS SDAGALMYPN YAFSEPSTYT LPQDDINGIQ AIYGPSNNPI
Nomascus_leucogenys         EETWTKTSTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSTYS LPQDDIDGIQ AIYGPSSNPI
Nycticebus_coucang          EETWTTTAVN YNLFLVAAHE FGHSLGLSHS TDPGALMYPN YAFNDPSTYS LPQDDINGIQ AIYGPSSSPV
Otolemur_garnettii          EETWTTTSIN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFNEPSTYS LPQDDINGIQ AIYGPSNSPV
Pan_paniscus                EETWTDTSAN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDIDGIQ AIYGLSSNPI
Pan_troglodytes             EETWTDTSAN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDIDGIQ AIYGLSSNPI
Papio_anubis                EETWTKDFTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Piliocolobus_tephrosceles   EETWTTNSTN YNLFLVAAHE FGHSLGLAHS FDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Pongo_abelii                EETWTKTSAN YNLFIVAAHE FGHSLGLAHS SDPGALMYPN YAFTETSNYS LPQDDIDGIQ AIYGPSSNPV
Pongo_pygmaeus              EETWTKTSAN YNLFIVAAHE FGHSLGLAHS SDPGALMYPN YAFTETSNYS LPQDDIDGIQ AIYGPSSNPV
Saimiri_boliviensis         EETWTSTSEN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYS LPQDDINGIQ AIYGPSSNPI
Sapajus_apella              EETWTNTPEN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYS LPQDDINGIQ AIYGPSSNPI
Symphalangus_syndactylus    EETWTKTSAN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSTYS LPQDDIDGIQ AIYGPSSNPI
Theropithecus_gelada        EETWTKDFTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Trachypithecus_francoisi    EETWTTNSTN YNLFLVAAHE FGHSLGLAHS FDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
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Mus_musculus                    QPTGPSTPKA CDPHLRFDAT TTLRGEIYFF KDKYFWRRHP QLRTVDLNFI SLFWPFLPNG LQAAYEDFDR
Aotus_nancymaae                 QPTGPSTPRP CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Carlito_syrichta                QPTGPSTPRT CDPRLTFDAI TTLRGEIFFF RDKYFWRRHP QLRSIEFNFI SLFWPALPDS IQAAYEDLDR
Cebus_imitator                  QPTGPSTPRP CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Gorilla_gorilla                 QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Lemur_catta                     QPTGPSTPRS CDPRLTFDAI TTLRGEILFF KDKYFWRRHP QLRSVELNFI SLFWPNLPNG IQAAYEDFDR
Macaca_mulatta                  QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Macaca_nemestrina               QPTGPTTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Microcebus_murinus              QPTGPSTPMA CDPRLTFDAI TTLRGEIFFF KDKYFWRRHP QLRSVELNFI SLFWPSLPNG IQAAYEDFDK
Nomascus_leucogenys             QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDSDR
Nycticebus_coucang              QPTGPSTPRT CDPRLTFDAI TTLRGEILFF KDKYFWRKHP QLPTVELNFI SLFWPSLPNG IQAAYEDFDR
Otolemur_garnettii              QPTGPSTPRT CDPRLTFDAI TTLRGEILFF KDKYFWRKHP QLPTAELNFI SLFWPSLPNG IQAAYEDFER
Pan_paniscus                    QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Pan_troglodytes                 QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Papio_anubis                    QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Piliocolobus_tephrosceles       QPTGPSTPES CDPRLTFDAI TTLRGEILFF KDEYFWRRHP WLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Pongo_abelii                    QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRIEMNFI SLFWPSLPTG MQAAYEDFDR
Pongo_pygmaeus                  QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRIEMNFI SLFWPSLPTG MQAAYEDFDR
Saimiri_boliviensis             QPTGPSTPRS CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLRRVEMNFI SLFWPSLPTG IQAAYEDFDR
Sapajus_apella                  QPTGPSTPRP CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Symphalangus_syndactylus        QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Theropithecus_gelada            QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Trachypithecus_francoisi        QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
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Homo_sapiens                 DLIFLFKGNQ YWALSGYDIL QGYPKDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Mus_musculus                 DLVFLFKGRQ YWALSGYDLQ QGYPRDISNY GFPRSVQAID AAVSYNGKTY FFINNQCWRY DNQRRSMDPG
Aotus_nancymaae              DLVFLFKGNQ YWALSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Carlito_syrichta             DLVFLFKGNQ YWAMNGYDLQ PGYPRDISNY GFPSNVQAID AAVYFRSKTY FFVNDQFWRY DNERQTMEPG
Cebus_imitator               DLVFLFKGNQ YWALSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQLMEPG
Gorilla_gorilla              DLIFLFKGNQ YWALSGYDIL QGYPKDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Lemur_catta                  DLVFLFKGNQ YWALSGYDIQ QGYPRYISNY GFPSTVQAID AAVSYGSETY FFVNDQFWRY DNQRQAMDPG
Macaca_mulatta               DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Macaca_nemestrina            DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Microcebus_murinus           DLVFLFKGNQ YWAMSGYDIQ QGYPRHISNY GFPSNVQAID AAVSYGRKTY FFVNDQLWRY DNQRQAMDPG
Nomascus_leucogenys          DLIFLFKGNQ YWALSGYDIQ QGYPKSISNY GFPCSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Nycticebus_coucang           DLVFLFKGNQ YWALNGYDIQ EGYPRDISNY GFPSTVQAID AAVSYRRKTY FFVNDQFWRY DNQRQLMEPG
Otolemur_garnettii           DLVFLFKGNQ YWALNGYEIQ QGYPRDISNY GFPSTVQAVD AAVFYRRKTY FFVNDQFWRY DNQRQFMEPG
Pan_paniscus                 DLIFLFKGNQ YWALSGYDIL QGYPKDIANY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Pan_troglodytes              DLIFLFKGNQ YWALSGYDIL QGYPKDIANY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Papio_anubis                 DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Piliocolobus_tephrosceles    DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Pongo_abelii                 DLIFLFKGNQ YWALSGYDIL QGYPKNISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Pongo_pygmaeus               DLIFLFKGNQ YWALSGYDIL QGYPKNISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Saimiri_boliviensis          DLVFLFKGNQ YWALSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYKSKTY FFVNDQFWRY DNQRQFMEPG
Sapajus_apella               DLVFLFKGNQ YWALSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQLMEPG
Symphalangus_syndactylus     DLIFLFKGNQ YWALSGYDIQ QGYPKSISNY GFPCSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Theropithecus_gelada         DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Trachypithecus_francoisi     DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
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Mus_musculus                YPKSIPSMFP GVNCRVDAVF LQDSFFLFFS GPQYFAFNFV SHRVTRVARS NLWLNCS--
Aotus_nancymaae             YPQSISYIFP GIESKVDAVF QQEHFFLFFS GPLYYAFDLS AQRVTRVARG NKWLNCR--
Carlito_syrichta            YPKSTLSIFP GIESKVDAVF QQNYFFFFFS GPRFYAFDLQ AHRVTRVDRS NRWLNCR--
Cebus_imitator              YPQRISDIFP GIERKVDAVF QQEHFFLFFS GPIYYAFDLS AQRVTRVARG NKWLNCR--
Gorilla_gorilla             YPKSISGAFP GIESKVDAVF QQQHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Lemur_catta                 YPQSILRTFP GIQSKVDAVF QKDDFFLFFS GPLYYAFNLS TRRVTRIDRS NKWLNCR--
Macaca_mulatta              YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Macaca_nemestrina           YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Microcebus_murinus          YPQSISSTFP GIQSRVDAVF QQDDFFLFFS GPRYYAFNLS TNRVTRLDKS NKWLNCR--
Nomascus_leucogenys         YPKSISGTFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVERG NKWLNCRYG
Nycticebus_coucang          YPKSLSTAFP GIESRVDAVF QRDYVFLFFS GPRYYAFDLN TRRVIRIDRS NIWLNCR--
Otolemur_garnettii          YPKSISTAFP GIESRVDAVF HRDYVFVFFS GPRYYAFDLN TRRVIRIDRS NKWLNCR--
Pan_paniscus                YPKSISGAFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Pan_troglodytes             YPKSISGAFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Papio_anubis                YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Piliocolobus_tephrosceles   YPKSTSGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTTVARA NEWLNCRYS
Pongo_abelii                YPKSISDTFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Pongo_pygmaeus              YPKSISDTFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCR--
Saimiri_boliviensis         YPQSISGIFP GIESKVDAVF QQEHFFLFFS GPIYYAFDLS AQRVTKIARG NKWLNCR--
Sapajus_apella              YPQRISDIFP GIERKVDAVF QQEHFFLFFS GPIYYAFDLS AQRVTRVARG NKWLNCR--
Symphalangus_syndactylus    YPKSISDTFP GIESKVDAVF QQERFFLFFS GPRYYAFDLI AQRVTRVERG NKWLNCRYG
Theropithecus_gelada        YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Trachypithecus_francoisi    YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
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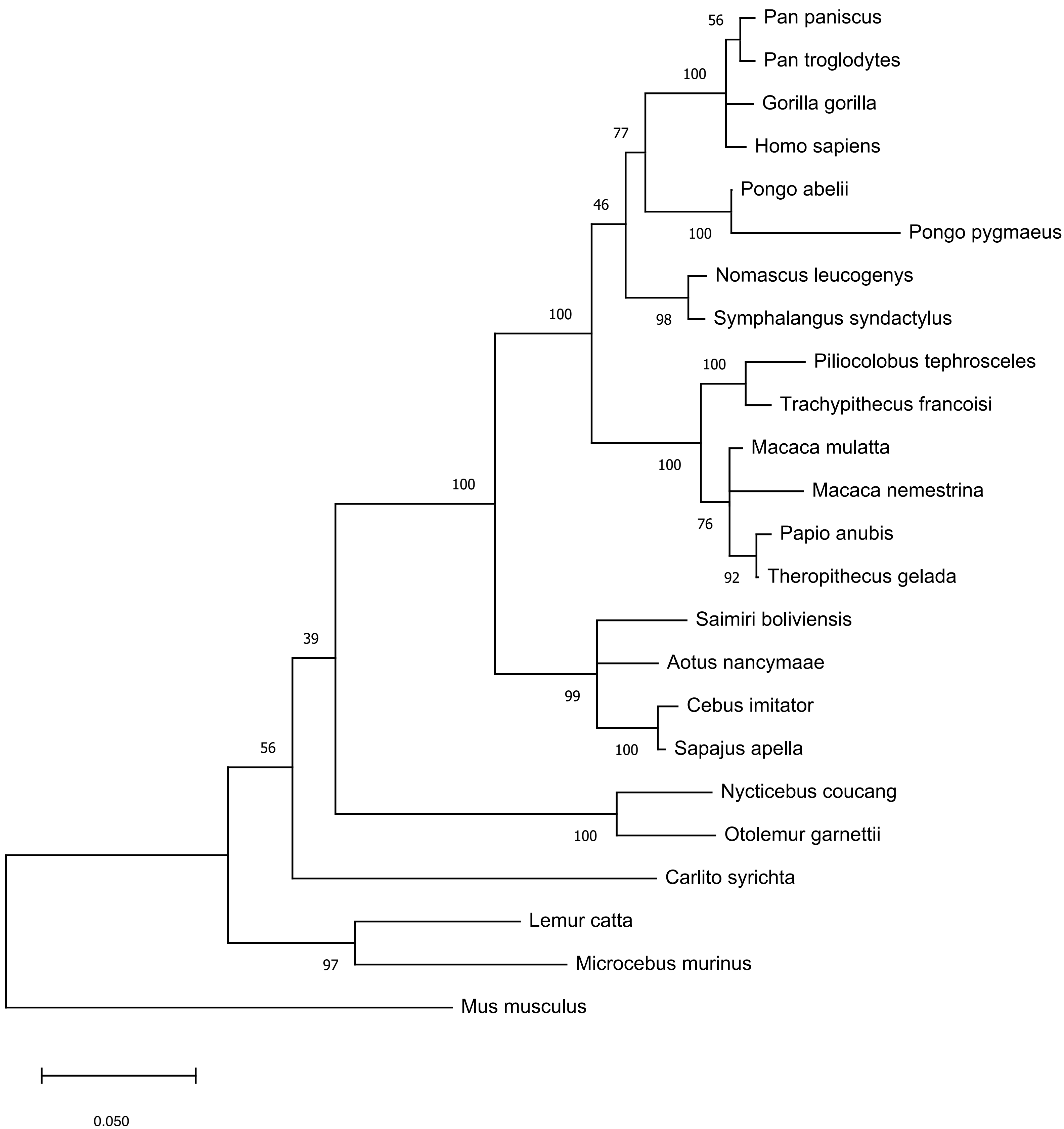
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Pan troglodytes
Gorilla gorilla
Homo sapiens
Pongo abelii
Pongo pygmaeus
Nomascus leucogenys
Symphalangus syndactylus
Piliocolobus tephrosceles
Trachypithecus francoisi
Macaca mulatta
Macaca nemestrina
Papio anubis
Theropithecus gelada
Saimiri boliviensis
Aotus nancymaae
Cebus imitator
Sapajus apella
Nycticebus coucang
Otolemur garnettii
Carlito syrichta
Lemur catta
Microcebus murinus
Mus musculus
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Mus_musculus                 MHSAILATFF LLSWTPCWSL PLPYGDDDDD DLSEEDLVFA EHYLKSYYHP ATLAGILKKS TVTSTVDRLR
Aotus_nancymaae              MHLGVLAAFL FLNWTHCRAL PLPNG-DDED DLSEEDLQFA ERYLKLYYHP TNLAGILKKN SANSMADRLR
Carlito_syrichta             MHPGVLTAFL LLCWTQCQSL PLPNG-EDED DTSEEDLQFA ERYLRSFYHP VNLAGILKKN AASSMVDRLR
Cebus_imitator               MHPGVLAAFL FLSWTHCWAL PLPNG-DDED DLSEEDLQFA ERYLKLYYHP TNLAGILKKN SASSMTDRLR
Gorilla_gorilla              MHPGVLAAFL FLSWTHSRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Lemur_catta                  MHPGILVAFL FLSWTHCRSL PLPNG--DDD DLSEEDLQFA ERYLKSYYHP PNLAGILKET SASSMVDRLR
Macaca_mulatta               MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Macaca_nemestrina            MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Microcebus_murinus           -MQGVLVAFL FLSWTHCRSL PLPDG--DDD DLSEEDLQFA ERYLKSYYHP PILAGILKKT SASSMVDRLR
Nomascus_leucogenys          MHPGILAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Nycticebus_coucang           MLPGVLLAFL FLSWTHCRAL PLPND-DDDD DLSEEDLQFA ERYLKSYYYP PNLAGILKKT SASSMIDRLR
Otolemur_garnettii           MLPRVLLAFL FLSWTPCRAL PLPNG--DDD DLSEEDLQFA EHYLKSYYHP LNLAGILKKT SASSMIDRLR
Pan_paniscus                 MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTERLR
Pan_troglodytes              MHPGVLAAFL FLSWAHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTERLR
Papio_anubis                 MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Piliocolobus_tephrosceles    MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Pongo_abelii                 MHPGVLAAFL FLSWTHCRAL PLPSD-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Pongo_pygmaeus               MHPGVLAAFL FLSWTHCRAL PLPSD-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Saimiri_boliviensis          MHPGVLAAFL FLSWTHCRAL PLPNG-DDED DLSEEDLQFA ERYLKLYYHP TNLAGILKKN SASSMTDRLR
Sapajus_apella               MHPGVLAAFL FLSWTHCWAL PLPNG-DDED DLSEEDLQFA EHYLKLYYHP TNLAGILKKN SASSMTDRLR
Symphalangus_syndactylus     MHPGILAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Theropithecus_gelada         MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Trachypithecus_francoisi     MHPVVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
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Homo_sapiens                  EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Mus_musculus                  EMQSFFGLEV TGKLDDPTLD IMRKPRCGVP DVGEYNVFPR TLKWSQTNLT YRIVNYTPDM SHSEVEKAFR
Aotus_nancymaae               EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Carlito_syrichta              EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIENYTPDM PHSEVEKAFK
Cebus_imitator                EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWPKMNLT YRIVNYTPDM THSEVEKAFK
Gorilla_gorilla               EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Lemur_catta                   EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWTQTNLT YRIVNYTPDM PHSEVEKAFK
Macaca_mulatta                EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Macaca_nemestrina             EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Microcebus_murinus            EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWTQTNLT YRIVNYTPDM THSEVEKAFK
Nomascus_leucogenys           EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Nycticebus_coucang            EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWTKTNLT YRIVNYTPDM THSEVEKAFK
Otolemur_garnettii            EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWTKTNLT YRIVNYTPDM THSEVEKAFK
Pan_paniscus                  EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Pan_troglodytes               EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Papio_anubis                  EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Piliocolobus_tephrosceles     EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
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Saimiri_boliviensis           EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWSRMNLT YRIVNYTPDM THSEVEKAFK
Sapajus_apella                EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWPKMNLT YRIVNYTPDM THSEVEKAFK
Symphalangus_syndactylus      EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Theropithecus_gelada          EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Trachypithecus_francoisi      EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWSKVNLT YRIVNYTPDM THSEVEKAFK
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Mus_musculus                KAFKVWSDVT PLNFTRIYDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Aotus_nancymaae             KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Carlito_syrichta            KAFKVWSDVT PLNFTRMHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Cebus_imitator              KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Gorilla_gorilla             KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Lemur_catta                 KAFKVWSDVT PLNFTRLHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Macaca_mulatta              KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Macaca_nemestrina           KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Microcebus_murinus          KAFKVWSDVT PLNFTRLHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNLGGDA HFDDDETWTS
Nomascus_leucogenys         KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Nycticebus_coucang          KAFKVWSDVT PLNFTRLHDG TADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Otolemur_garnettii          KAFKVWADVT PLNFTRLHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pan_paniscus                KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pan_troglodytes             KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Papio_anubis                KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Piliocolobus_tephrosceles   KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pongo_abelii                KAFKVWSDVT PLNFTRLHNG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pongo_pygmaeus              KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Saimiri_boliviensis         KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Sapajus_apella              KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Symphalangus_syndactylus    KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Theropithecus_gelada        KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Trachypithecus_francoisi    KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
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Carlito_syrichta                SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK NHFVLPDDDV QGIQTLYGPG DEDPNPKHPK
Cebus_imitator                  SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTSK SHFMLPDDDV QGIQFLYGPG DEDPNPKHPK
Gorilla_gorilla                 SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Lemur_catta                     SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFVLPDDDV QGIQSLYGPG DEDPNPKHPK
Macaca_mulatta                  SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Macaca_nemestrina               SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
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Nycticebus_coucang              SSKGYNLFLV AAHELGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPEDDV QGIQFLYGPG DEDPNPKHPK
Otolemur_garnettii              SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFVLPEDDV QGIQSLYGPG DEDPNPKHPK
Pan_paniscus                    SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Pan_troglodytes                 SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Papio_anubis                    SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFVLPDDDV QGIQSLYGPG DEDPNPKHPK
Piliocolobus_tephrosceles       SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Pongo_abelii                    SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Pongo_pygmaeus                  SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Saimiri_boliviensis             SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTSK NHFMLPDDDV QGIQFLYGPG DEDPNPKHPK
Sapajus_apella                  SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTSK SHFMLPDDDV QGIQFLYGPG DEDPNPKHPK
Symphalangus_syndactylus        SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Theropithecus_gelada            SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFVLPDDDV QGIQSLYGPG DEDPNPKHPK
Trachypithecus_francoisi        SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
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Aotus_nancymaae               TPDKCDPSLS LDAITSLRGE TMVFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSRDLIFIF
Carlito_syrichta              TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSRDLIFIF
Cebus_imitator                TPDKCDPSLS LDAITSLRGE TMVFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Gorilla_gorilla               TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSYDLIFVF
Lemur_catta                   TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPAHDLVFVF
Macaca_mulatta                TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Macaca_nemestrina             TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Microcebus_murinus            TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLVFFF
Nomascus_leucogenys           TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Nycticebus_coucang            TPDKCDPSLS LDAITSLRGE TIIFKDRFFW RLHPQQVDAE LFLTKSFWME LPNRIDAAYE HPSHDLVFIF
Otolemur_garnettii            TPDKCDPSLS LDAITNLRGE TIIFKDRFFW RLHPQQVDAE LFLTKSFWLE LPNRIDAAYE HPSHDLVFIF
Pan_paniscus                  TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Pan_troglodytes               TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Papio_anubis                  TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Piliocolobus_tephrosceles     TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Pongo_abelii                  TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
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Sapajus_apella                TPDKCDPSLS LDAITSLRGE TMVFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Symphalangus_syndactylus      TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Theropithecus_gelada          TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Trachypithecus_francoisi      TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
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Carlito_syrichta              RGRKFWALNG YDIMEGYPQK ISELGFPKEV KKISAAVHFE DTGKTLFFSG NQVWSYDDTN HVMDKDYPRF
Cebus_imitator                RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGRTLFFSG NQVWRYDDTN QIMDKDYPRL
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Macaca_mulatta                RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Macaca_nemestrina             RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Microcebus_murinus            RGRKFWALNG YDIMEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLFFSG NQVWRYDDTN QIMDKDYPRL
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Papio_anubis                  RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
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Pongo_pygmaeus                RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Saimiri_boliviensis           RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLFFSG NQVWRYDDTN QIMDKDYPRL
Sapajus_apella                RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGRTLFFSG NQVWRYDDTN QIMDKDYPRL
Symphalangus_syndactylus      RGRKFWALNG YDILEGYPQK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Theropithecus_gelada          RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Trachypithecus_francoisi      RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
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Aotus_nancymaae              IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSKRI VRVMPANSIL
Carlito_syrichta             IEEVFPGIGD KVDAVYEKNG YIYFFNGPIQ FEF------- ---------- ---SVWSKRI VRVMTANSLL
Cebus_imitator               IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSKRI VRVMPANSIL
Gorilla_gorilla              IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Lemur_catta                  IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPTNSLL
Macaca_mulatta               IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Macaca_nemestrina            IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Microcebus_murinus           IEEDFPGIGD KVDAVYEKNG YIYFFSGPIQ FEY------- ---------- ---SIWSNRI VRVMPTNSLL
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Nycticebus_coucang           IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSDRI VRVMPTNALL
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Saimiri_boliviensis          IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSKRI VRVMPANSIL
Sapajus_apella               IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSKRI VRVMPANSIL
Symphalangus_syndactylus     IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Theropithecus_gelada         IEEDFPGIGD KVDAVYEKNE SHFVVQAGVQ WHNLSSLQPP PPGFKRFSCL SLRSSWNYRL YLFFQRAHTV
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Homo_sapiens                        WC
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Lemur_catta                         WC
Macaca_mulatta                      WC
Macaca_nemestrina                   LC
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Nomascus_leucogenys                 WC
Nycticebus_coucang                  WC
Otolemur_garnettii                  WC
Pan_paniscus                        WC
Pan_troglodytes                     WC
Papio_anubis                        WC
Piliocolobus_tephrosceles           WC
Pongo_abelii                        WC
Pongo_pygmaeus                      WC
Saimiri_boliviensis                 WC
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Theropithecus_gelada                --
Trachypithecus_francoisi            WC
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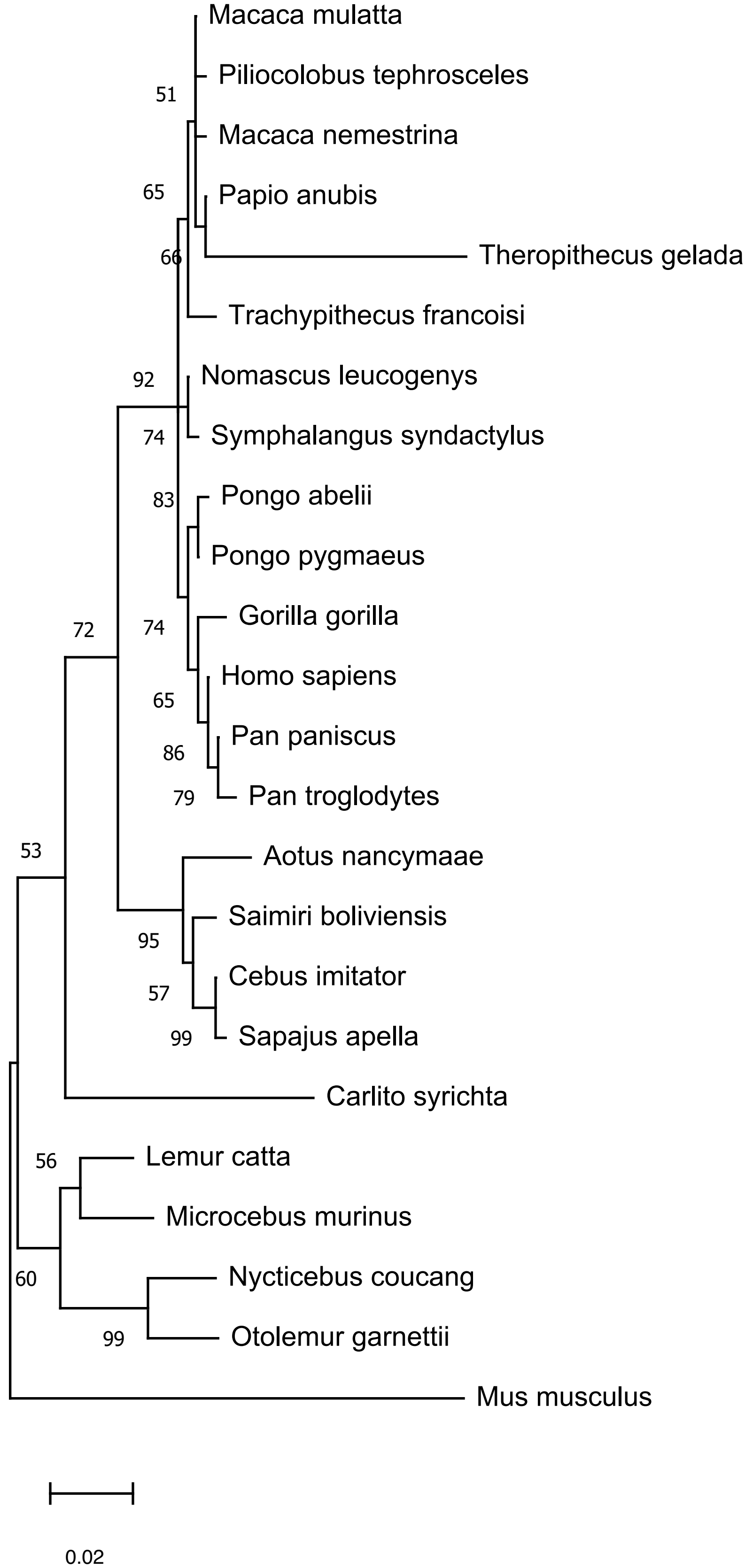
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Trachypithecus francoisi
Nomascus leucogenys
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Pongo abelii
Pongo pygmaeus
Gorilla gorilla
Homo sapiens
Pan paniscus
Pan troglodytes
Aotus nancymaae
Saimiri boliviensis
Cebus imitator
Sapajus apella
Carlito syrichta
Lemur catta
Microcebus murinus
Nycticebus coucang
Otolemur garnettii
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A glimpse on the discussions…

# A STUDY ON GRASSHOPPER DIVERSITY IN CHRIST COLLEGE (AUTONOUMOUS), IRINJALAKUDA

**DEPARTMENT OF ZOOLOGY,**
**CHRIST COLLEGE (AUTONOMOUS),**
**IRINJALAKUDA**
**THRISSUR, KERALA-680 125**

**MARCH 2024**

# A STUDY ON GRASSHOPPER DIVERSITY IN CHRIST COLLEGE IRINJALAKUDA

***Project report submitted to the University of Calicut in partial fulfillment of the requirement for the award of the Degree***

**BACHELOR OF SCIENCE**
**IN ZOOLOGY**

| Sl No. | Group members | Register No. |
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| 2. | ALEENA MARIYA | CCAVSZO016 |
| 3. | ANAGHA ARUN M A | CCAVSZO004 |
| 4. | ANAGHA SAIBU | CCAVSZO018 |
| 5. | ANJIMA JOSE | CCAVSZO020 |
| 6. | MARIYA T J | CCAVSZO028 |
| 7. | NEETHU N M | CCAVSZO009 |
| 8. | RAHMA | CCAVSZO011 |
| 9 | SANDRA K SHAJU | CCAVSZO032 |

**DEPARTMENT OF ZOOLOGY**
**CHRIST COLLEGE (AUTONOMOUS) IRINJALAKUDA**
**THRISSUR, KERALA 680125**

**Examiners:**

**1.** **2.**

# DECLARATION

We, Akshay K A, Aleena Mariya, Anagha Arun M A, Anagha Saibu, Anjima Jose, Mariya T J, Neethu N M, Rahma and Sandra K Shaju, do hear by declare that this project entitled "**Study on grasshopper diversity in Christ College (Autonomous), Irinjalakuda**" is a genuine record of project work done by us under the guidance of Dr. Bijoy C., Assistant Professor, Department of Zoology, Christ College (Autonomous), Irinjalakuda, and has not been submitted to any university or Institution for the Award of any Degree or Diploma.

We further declare that results presented in this work and considerations made therein, contribute in general to the advancement of knowledge in science.

| Sl. No | Register Number | Name | Signature |
|---|---|---|---|
| 1 | CCAVSZO002 | AKSHAY K A | |
| 2 | CCAVSZO016 | ALEENA MARIYA | |
| 3 | CCAVSZO004 | ANAGHA ARUN M A | |
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| 7 | CCAVSZO009 | NEETHU N M | |
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| 9 | CCAVSZO032 | SANDRA K SHAJU | |

Place: Irinjalakuda

Date:

SHADPADA
ENTOMOLOGY
RESEARCH
LAB

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Dr Bijoy C.
Assistant Professor,
Research Department of Zoology,
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Mob: 9895551003

# CERTIFICATE

This is to certify that the content of this project work entitled "**STUDY ON GRASSHOPPER DIVERSITY IN CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA**" is an original work done by the following students under my supervision and guidance at the Department of Zoology, Christ College (Autonomous), Irinjalakuda. I further certify that no part of the work has been presented for the award of any other Degree or Diploma.

| Sl. No | Register Number | Group members |
|---|---|---|
| 1 | CCAVSZO002 | AKSHAY K A |
| 2 | CCAVSZO016 | ALEENA MARIYA |
| 3 | CCAVSZO004 | ANAGHA ARUN M A |
| 4 | CCAVSZO018 | ANAGHA SAIBU |
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| 6 | CCAVSZO028 | MARIYA T J |
| 7 | CCAVSZO009 | NEETHU N M |
| 8 | CCAVSZO011 | RAHMA |
| 9 | CCAVSZO032 | SANDRA K SHAJU |

**Place:** Irinjalakuda

**Date:**

**Dr. Bijoy C.**

Project Supervisor

## CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA

## DEPARTMENT OF ZOOLOGY

# CERTIFICATE

This is to certify that the project work entitled **‘A study on grasshopper diversity in Christ College (Autonomous) Irinjalakuda'** is an authentic record of research work carried out by **Akshay K A, Aleena Mariya, Anagha Arun M A, Anagha Saibu, Anjima Jose, Mariya T J, Neethu N M, Rahma** and **Sandra K Shaju** as a part of B.Sc. practical during the year 2022- 2023 and the results of this work has not been presented for the award of any other degree/diploma in any university.

Place: Irinjalakuda

Date:

**Dr. Sudhikumar A. V.**

Head, Department of Zoology,

Christ College, Irinjalakuda

## ACKNOWLEDGMENTS

The success and final outcome of this project required a lot of guidance and assistance from people. Whatever we have done is only due to such guidance and assistance and we would like to express our gratitude to the following individuals without whom the work would not have been completed.

Firstly, we would like to express our heartfelt gratitude to the Almighty for providing us with the strength, wisdom, and perseverance throughout the course of this project.

We would like to express our sincere gratitude to Dr Bijoy C, Assistant Professor, Department of Zoology, Christ College, Irinjalakuda, for providing necessary advice, for his patience in bearing our ideas, and for all the efforts he made to see this project through to completion. This study would not be possible without his tremendous help and guidance. His dedication to academic excellence has been truly inspiring.

We are deeply indebted to Dr A.V. Sudhikumar, Head of Department of zoology, Christ College, Irinjalakuda, as well as all other teaching and non-teaching department personnel, for the suggestions.

We are also grateful to Rev. Dr Jolly Andrews CMI, Principal of Christ College Irinjalakuda, for providing all available resources for this project and for fostering an environment of learning and excellence at college.

We are immensely grateful to Ms. Thasnim E S, Research scholar at Shadpada Entomology Research Lab (SERL), Christ College, Irinjalakuda, for the identification of specimens, providing necessary ideas from the start of this project and for her valuable insights, and contributions to this project. Her dedication and expertise have been invaluable assets throughout the process.

Lastly, we extend our heartfelt thanks to our family for their encouragement, and support during the field trips.

# CONTENTS

# ABSTRACT

The present study is an attempt to find the diversity of grasshoppers in Christ College campus, to calculate the relative abundance of collected grasshoppers and to study their variations according to seasons and habitats. The study was carried out in four sites of Christ College campus, Irinjalakuda, Thrissur district, Kerala. Collection was done on two different seasonal period from monsoon to post monsoon. Post monsoon has the maximum species richness and monsoon shows more species diversity. According to our study, we observed 19 grasshopper species, Family Acrididae is the most abundant and Family Tetrigidae has the least abundance.

# A Bioinformatic Study on the Molecular Evolution of Collagenases in Primates

*A project report submitted to the **University of Calicut** in partial fulfilment of the requirement for the award of the Degree*

## BACHELOR OF SCIENCE IN ZOOLOGY

BY



| Sl. No. | Name of students in the group | Register No. |
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| 1 | Chandana Janardhanan | CCAVSZO005 |
| 2 | Lakshmi AP | CCAVSZO008 |
| 3 | Niharika | CCAVSZO010 |
| 4 | Salvador VS | CCAVSZO012 |
| 5 | Abhinav Krishna PV | CCAVSZO013 |
| 6 | Aysha Nedha Sakir | CCAVSZO022 |
| 7 | Mithralmajan PT | CCAVSZO029 |
| 8 | Anjima NC | CCAVSZO035 |
| 9 | Grace Maria Paulson | CCAVSZO036 |

DEPARTMENT OF ZOOLOGY

CHRIST COLLEGE (AUTONOMOUS)
IRINJALAKUDA, THRISSUR, KERALA – 680125


MARCH 2024

# CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA
# DEPARTMENT OF ZOOLOGY

## CERTIFICATE

This is to certify that the project work entitled **'A Bioinformatic Study on the Molecular Evolution of Collagenases in Primates'** is an authentic record of research work carried out by **Chandana Janardhanan, Lakshmi AP, Niharika, Salvador VS, Abhinav Krishna PV, Aysha Nedha Sakir, Mithralmajan PT, Anjima NC** and **Grace Maria Paulson** as part of BSc syllabus during the year **2023-2024** and the results of this work has not been presented for the award of any other degree/ diploma in any university.

### Certified bona fide by

**Dr. Leyon Varghese**
Supervising Guide

**Dr Sudhikumar A. V.**
Head, Department of Zoology

Date :

Place :

### Examined by

1. ______________________________

2. ______________________________

# DECLARATION

We, the following students do hereby declare that this project report entitled **'A Bioinformatic Study on the Molecular Evolution of Collagenases in Primates'** is a genuine record of the project work done by us under the guidance of Dr. Leyon Varghese, Assistant Professor, Department of Zoology, Christ College (Autonomous), Irinjalakuda and that this report has not been submitted to any University/Institution for the award of any Degree or Diploma. We further declare that the results presented in this work and considerations made therein, contribute in general to the advancement of knowledge in science and is devoid of any plagiarism.

| Sl. No. | Name of Students | Register No. | Signature |
|---|---|---|---|
| 1 | Chandana Janardhanan | CCAVSZO005 | |
| 2 | Lakshmi AP | CCAVSZO008 | |
| 3 | Niharika | CCAVSZO010 | |
| 4 | Salvador VS | CCAVSZO012 | |
| 5 | Abhinav Krishna PV | CCAVSZO013 | |
| 6 | Aysha Nedha Sakir | CCAVSZO022 | |
| 7 | Mithralmajan PT | CCAVSZO029 | |
| 8 | Anjima NC | CCAVSZO035 | |
| 9 | Grace Maria Paulson | CCAVSZO036 | |

Place : Irinjalakuda

Date : 28-02-2024

# CONTENTS

## INTRODUCTION

The first true primates evolved around 55 million years ago or a bit earlier, near the beginning of the Eocene Epoch. Their fossils have been found in North America, Europe, and Asia. They looked different from the present day primates. Changes in gene regulation and differences in mRNA expression levels across primates have often been documented, however, it is not yet known to what extent measurements of divergence in mRNA levels reflect divergence in protein expression levels, which are probably more important in determining phenotypic differences. Collagenases, a subgroup of Matrix matalloproteases (MMPs) are a large family of zinc-dependent endopeptidases with a great affinity for several components of the extracellular matrix. The collagenases include MMP-1 (interstitial collagenase/collagenase-1), MMP-8 (neutrophil collagenase/collagenase-2), and MMP-13 (collagenase-3). These MMPs attack triple helical regions of interstitial collagen types I, II, and III at a specific single site after the Gly residue of the partial sequences Gly-(Ile or Leu)-(Ala or Leu), located about three-fourths of the distance from the N-terminus. This cleavage generates fragments approximately three-fourths and one-fourth of the size of the collagen molecules. They are distinct from a closely related gelatinases (MMP2 and 9) that are characterized by the presence of the additional fibronectin domain located inside the catalytic domain.

A phylogenetic tree or evolutionary tree is a graphical representation which shows the evolutionary history between a set of species or taxa during a specific time. In other words, it is a branching diagram or a tree showing the evolutionary relationships among various biological species or other entities based upon similarities and differences in their physical or genetic characteristics. In evolutionary biology, all life on Earth is theoretically part of a single phylogenetic tree, indicating common ancestry. Phylogenetics is indeed the study of this phylogenetic tree. The main challenge is to find a phylogenetic tree representing optimal evolutionary ancestry between a set of species or taxa. The first step in the phylogenetic tree construction (using bioinformatics tool) with a new sequence would be to use BLAST. This nifty yet powerful resource matches your sequence to the millions of sequences stored in genomic and nucleotide databases. The tool comes up with the sequences most similar to the query submitted.

It also gives insights as to the possible identity of those sequences. The results include homologues across species and in similar tissues or organisms. A sequence alignment is a way of arranging the sequences of DNA, RNA, or protein to identify regions of similarity that may be a consequence of functional, structural, or evolutionary relationships between the sequences. If two sequences in an alignment, they share a common ancestor and mismatches can be interpreted as point mutations and gaps as indels (that is, insertion or deletion mutations) introduced in one or both lineages in the time since they diverged from one another. In sequence alignments of proteins, the degree of similarity between amino acids occupying a particular position in the sequence can be interpreted as a rough measure of how conserved a particular region or sequence motif is among lineages.

Phylogenetics and sequence alignment are closely related fields due to the shared necessity of evaluating sequence relatedness. The field of phylogenetics makes extensive use of sequence alignments in the construction and interpretation of phylogenetic trees, which are used to classify the evolutionary relationships between homologous genes represented in the genomes of divergent species. The degree to which sequences in a query set differ is qualitatively related to the sequences evolutionary distance from one another. Roughly, high sequence identity suggests that the sequences in question have a comparatively young most recent common ancestor, while low identity suggests that the divergence is more ancient. This approximation, which reflects the “molecular clock” hypothesis that a roughly constant rate of evolutionary change can be used to extrapolate the elapsed time since two genes first diverged , assumes that the effects of mutation and selection are constant across sequence lineages.

**REVIEW OF LITERATURE**

Primates are unique among placental mammals. Two extreme type of placentation are present in this single order. Strepsirrhines have non-invasive epitheliochorial placentation and Haplorhines have highly invasive haemochorial placentation. Strepsirrhines include Lemurs and Lorisiforms and Haplorhines include tarsiers and higher primates. Resemblance in placenta type provide the first evidence that tarsiers are linked to higher primates and distinct from lemurs and lorisiforms. Tree-shrews have endotheliochorial placentation and differ from both primate subgroups. Endotheliochorial placentation is primitive and epitheliochorial placentation is unlikely to be primitive.The recent availability of comprehensive molecular phylogenies for placental mammals has provided an independent framework to determine the most parsimonious interpretation of the evolution of placenta types (Robert Martin, 2008). In an earlier elaborate study, speciation between primates and rodents was estimated by looking at the protein coding genes of mitochondrial genomes from 31 mammals (A.D Yoder 2000). Based on paleontological data, three calibration points were used: one at 20–25 MYA for the hominoid/cercopithecoid divergence, one at 53–57 MYA for the cetacean/artiodactyl divergence, and the third at 110–130 MYA for the metatherian/eutherian divergence. Nulceotide and the amino acid sequence were looked at and results produced that were not mutually exclusive.

Even with decades of data and methods, we still can't agree on the exact evolutionary tree of higher primates (apes and humans). The most likely scenario has humans closest to chimps, but other possibilities exist. Despite numerous theories, 20 key reasons cause this uncertainty. New methods using DNA offer hope for more definitive answers. (Holmquist et al 1988). Primate phylogeny forms a solid framework for a novel depiction of diverse patterns of genome evolution among primate lineages. They are essential for future comparative genomic investigation of adaptation and selection in humans and across primates. Studies on the evolution of catarrhine primates were done using molecular, fossil and bio geographical data. It was found that the common ancestor of Old World Monkeys originated in Africa and some monkeys later moved to Asia around 10 million years ago. The study further suggested that the ancestor of the

living homininds left Africa about 20 mya and the common ancestor of the living African apes returned to Africa from Eurasia around 10 mya (Caro-Beth Stewart, Todd R Disotell 1998).

In the deep study of evolutionary roots of strepsirrhine primate labyrinthine morphology, geometric morphometric analysis showed that the labyrinthine morphology of extant strepsirrhines contains a mixed locomotor, allometric and phylogenetic signal. Discriminant analysis at the family level confirmed that labyrinthine shape is a good taxonomic marker. The results support the hypothesis that evolutionary change in labyrinthine morphology is adequately described with a random walk model, i.e. random phenotypic dispersal in morphospace (Lebrun et al, 2010). An overview of the taxonomy of New World primates based on morphology to the great number of studies based on molecular data aiming for the elucidation of the phylogeny of New World monkeys. The traditional classification of the infraorder Platyrrhini divided these primates into Cebidae and the Callitrichidae, with Callimico being allocated to either the former (Simons, 1972, Simpson, 1945) or the latter family. Hill (1957) and Hershkovitz, 1972, Hershkovitz, 1977 proposed a third family – Callimiconidae – to accommodate Callimico, because it shares characteristics that define both cebids and callitrichids. According to Hershkovitz (1977), then all New World primates should be included in one of three families – the Callitrichidae which comprised the marmosets, tamarins (Saguinus) and lion tamarins (Leontopithecus), the monotypic Callimiconidae (Callimico) and the Cebidae (Schneider et al, 2015).

In a study on molecular phylogeny and evolution of primate mitochondrial DNA, researchers determined nucleotide sequences of homologous 0.9-kb fragments of mitochondrial DNAs (mtDNAs) derived from four species of old-world monkeys, one species of new-world monkeys, and two species of prosimians. With these nucleotide sequences and homologous sequences for five species of hominoids, they constructed a phylogenetic tree for the four groups of primates. The phylogeny obtained is generally consistent with evolutionary trees constructed in previous studies. The results also suggest that the rate of nucleotide substitution for mtDNAs in hominines (human, chimpanzee, and gorilla) have slowed down compared with that for old-world monkeys (Hayasaka, 1988). Mitochondrial genomes have been used to study the

phylogenetic relationship of primates in detail. Using 454 sequencing, the study adds 32 new complete mitochondrial genomes and introduces 20 previously unrepresented genera in the primate tree. The study focuses on the New world monkeys and suborder Strepsirrhini. (Knut Finstermeier, et al 2013). The evolutionary relationships of the number of species within the genus Lepilemur were analysed with the help of a comparative cytogenetic and molecular study. The study involved the complete sequencing of the mitochondrial cytochrome b gene from 68 individuals and the results were compared to those obtained from cytogenetic studies derived from 99 specimens. The results support the classification of the eight major supportive lemur taxa as independent species. (Nicole Andriaholinirina, et al. 2006)

The relationship between the prion protiens and new world primate phylogeny have been studied. The PrP C prion protein contains 250 amino acids with some variation among species and is expressed in several cell types. Variations in the prion protein gene were observed among 16 genera of New World primates (Platyrrhini), and resulted in amino acid substitutions when compared with the human sequence. Schneider et al, 2004)

Beta-globin gene cluster of primates were analyzed to understand their evolutionary history. The rate of accumulation of mutations have also been seen to vary by a factor of 7 among different primate lineages. The study groups superfamilies Lemuroidea and Lorisoidea into suborder Strepsirhini and Tarsius and Anthropoidea into suborder Haplorhini. Evolution rates have been suggested to have slowed down over the past 25 million years of hominoid descent and has found to have happened in correlation with lengthened lifespans (Koop, BF et al 1989).

Using the SINE's methods for the analysis of mobile element based of old world monkeys. It helps to known ancestral staples. Makes them to useful genetic studies for phylogenetic studies. Alu is an helping part of it, in this methods found 285 new Alu Insertions from sixteen old world monkeys. Old world monkeys are represent on the most diverse and largest primate families. And have respect classification. The phylogenetic researchers are classified and grouped the old world monkeys into different classes and divisions. Mainly the subfamily cerocopithecidae are the most studied group.. SINEs ( short interspersed element are

used  as the genetic markers this  will helps to analysis several levels of phylogenetic analysis. Using both Compcompuational and PCR methods (Xing a et al, 2005).

New world monkeys represent monophyletic group. The phylogenetic relationships among new world monkeys have been extensively investigated using nucleotide sequence from different genome.In these studies still there are some unresolved issues.There are three monophyletic new world monkey families Atelidae, Cebidae and Pitheciidae. As a result Maximum parsimony analysis support the three proposed platyrrhine families. In the maximum parsimony tree, the two most closely related families are Atelidae and Cebidae.Phylogenetic relationships were reconstructed by maximum parsimony, maximum likelihood, and Bayesian approaches (JuanC Opazo et al, 2006). Anthropoid primates from the neotropics are members of parvorder Platyrrhini. The platyrrhines are also called New World monkeys. There are more than 125 species of extant New World monkeys  found in approximately 15 genera. The phylogenetic relationships of these neotropical primates have been extensively studied from a molecular perspective (Derek wildman et al, 2009).

Phylogenetic trees are certainly useful for comparative studies, providing a useful framework for comparative biologists. Species evolution is not statistically independent. The fact that close relatives inherit characteristics from their common ancestor has always complicated the analysis of cross- species data. The methods in turn developed to resolve such issues, all requires resolved phylogeny. In one of the earlier studies, primates phylogeny was estimated of all 203 species of primates. Application of parsimony algorithm and bootstrapping resulted in the composite tree with 160 nodes (Purvis, Andy 1995).

In a project conducted under the support from National Cancer Institute and National Institute of Health, researchers constructed a robust phylogenetic tree of primates. The tree was constructed from the data collected of genomic sequences from 186 primates. Also outgroup species from Dermoptera, Scandentia and Lagomorpha was included. This phylogenetic representation done carefully was a notable illumination showing the pathway of primates evolution (Perelman et.al 2011).

Studies also estimated the molecular divergence dates of major primates in the context of molecular clock studies. Such studies also aid in understanding the lineage. Utilizing the genomic data, molecular divergence dates were able to be studied since alignments can be arranged and sites can be analysed for this study. Much before the molecular clock, paleontology used to provide only a mere timeframe of species evolution (Steiper et.al. 2006).

Inferring molecular phylogeny for evolutionary studies are done in non- primates as well. The molecular phylogeny of malarial parasites was recovered from mitochondrial cytochrome b gene sequences. Parsimony as well as maximum- likelihood analysis produced similar phylogenetic trees in this case. The conclusions were supported by hypothesis testing (Perkins et.al 2002). Inferring species super matrix has helped in studying macroevolutionary dynamics and even historical biogeography. The results obtained highlighted both the power as well as limitations of inferring the molecular phylogeny data to different species concepts (Springer et.al. 2012).

Over the past 60 million years, a million copies of Alu DNA have appeared in the genomes of primates. This is still an ongoing process. DNA alu repeats in the genomes of primates such as human, chimpanzee, gorilla, orangutan, baboon, rhesus, and macaque. New Alu elements arise in unique and irreversible events and appear to prevent precise excision and loss. The same insertions cannot occur independently in two species. Once the insert is genetically fixed, the DNA elements persist in all descendant lineages. Different from point mutation, the distribution of individual alu corresponds to a phylogeny only (H. Hamdi, 1999).

To resolve the debate in strepsirrhine phylogeny, 61 loci containing interspersed elements were characterized and the absence and presence of orthologous loci in the strepsirrhine panel was determined. According to these findings, it is concluded that strepsirrhines originated in Africa, and that Madagascar and Asia were colonized by immigration events (C. Roos, 2004). To investigate the phylogenetic relationships among species of New World monkeys, 1.3 kb of DNA was collected for 2 introns of the glucose-6-phosphate dehydrogenase locus encoded on the x chromosome of 24 species of New World monkeys (M. Von. Dornum, 1999).

Two molecular based approaches are used to date the initial divergence of the platyrrhine clade, a relaxed clock model using fossil record and genome datasets, and Bayesian inferences from generation time and body size to substitution rate. Fossil constraints, topology, and substitution rate are an important part of our divergence time estimates. making an impact. Bayesian estimates using conservative and realistic fossil constraints suggest that the LCA of extant platyrrhines is 29 Ma, with a 95% confidence interval for Nodine of 27–31 Ma (SI Perez, 2013). The sequences of nuclear protein-coding gene LCAT were used to study the relationship between 19 extant rodents. The study agrees with several previous molecular and morphological studies, both concerning branching orders inside Muroidea and the bush-like radiation of rodent suprafamilial taxa. This indicates that this nuclear gene is a fitting candidate for tackling questions about rodents relationships.

The data from primates were used to reveal that the molecular clock in CpG and non-CpG sites have different nature, projecting differences in their molecular origin. Through the process, it was observed that molecular clocks are heterogeneous even within a genome. During phylogenetic analysis and while concluding divergence times using molecular data, one should be mindful that different regions of genome follow different molecular clocks. In this study, our efforts are directed towards studying the pathway of certain collagenases in the course of evolution. Even though some studies have been done using DNA sequences and that too in different context, in our study we focusses primarily on amino acid sequences. This is not a well researched area. Though this study we aim on providing a new work in the area of comparative biology. The results of the work may be useful in the future providing insights into how may be the few crucial changes in amino acids may have resulted into a complete new lineage.

## SIGNIFICANCE OF THE STUDY

The study of molecular evolution in primates through the comparison of amino acid sequences using bioinformatics tools represents a novel and underexplored area of research. To date, there has been a notable scarcity of studies employing bioinformatics techniques to investigate the evolutionary patterns of primates, particularly in relation to proteins such as MMP1, MMP8 and MMP13 collagenases. The selection of these collagenases for our study is particularly significant due to their split genes nature. By conducting a comparative analysis of the evolutionary trees derived from the collagenases with established standard trees, we aimed to shed light on the distinctive evolutionary trajectories of these proteins in primates. The insights obtained from this comparative study have the potential to deepen our understanding of the molecular evolution of primates and elucidate the factors driving the evolution of collagenases in this taxonomic group.

**OBJECTIVES**

1. Retrieval of relevant data (Gene/mRNA/protein sequence of collagenases of primates) from relevant reliable resources such as NIH or SIB.
2. Align the retrieved sequences using bioinformatics software to ensure they are in the correct reading frame and homologous positions are appropriately aligned.
3. Construction of the phylogenetic trees based on the Gene/mRNA/protein sequence of collagenases in primates.

## METHODOLOGY

The three human collagenases used in the study are MMP1, MMP8 and MMP13. The FASTA sequence and other details of collagenases are as below.

```
>NP_002412.1 interstitial collagenase isoform 1 MMP1 UniProt_P03956 [Homo sapiens]
MHSFPPLLLLLFWGVVSHSFPATLETQEQDVDLVQKYLEKYYNLKNDGRQVEKRRNSGPVVEKLKQMQEF
FGLKVTGKPDAETLKVMKQPRCGVPDVAQFVLTEGNPRWEQTHLTYRIENYTPDLPRADVDHAIEKAFQL
WSNVTPLTFTKVSEGQADIMISFVRGDHRDNSPFDGPGGNLAHAFQPGPGIGGDAHFDEDERWTNNFREY
NLHRVAAHELGHSLGLSHSTDIGALMYPSYTFSGDVQLAQDDIDGIQAIYGRSQNPVQPIGPQTPKACDS
KLTFDAITTIRGEVMFFKDRFYMRTNPFYPEVELNFISVFWPQLPNGLEAAYEFADRDEVRFFKGNKYWA
VQGQNVLHGYPKDIYSSFGFPRTVKHIDAALSEENTGKTYFFVANKYWRYDEYKRSMDPGYPKMIAHDFP
GIGHKVDAVFMKDGFFYFFHGTRQYKFDPKTKRILTLQKANSWFNCRKN

>NP_002415.1 neutrophil collagenase isoform 1 MMP8 UniProt_P22894 [Homo sapiens]
MFSLKTLPFLLLLHVQISKAFPVSSKEKNTKTVQDYLEKFYQLPSNQYQSTRKNGTNVIVEKLKEMQRFF
GLNVTGKPNEETLDMMKKPRCGVPDSGGFMLTPGNPKWERTNLTYRIRNYTPQLSEAEVERAIKDAFELW
SVASPLIFTRISQGEADINIAFYQRDHGDNSPFDGPNGILAHAFQPGQGIGGDAHFDAEETWTNTSANYN
LFLVAAHEFGHSLGLAHSSDPGALMYPNYAFRETSNYSLPQDDIDGIQAIYGLSSNPIQPTGPSTPKPCD
PSLTFDAITTLRGEILFFKDRYFWRRHPQLQRVEMNFISLFWPSLPTGIQAAYEDFDRDLIFLFKGNQYW
ALSGYDILQGYPKDISNYGFPSSVQAIDAAVFYRSKTYFFVNDQFWRYDNQRQFMEPGYPKSISGAFPGI
ESKVDAVFQQEHFFHVFSGPRYYAFDLIAQRVTRVARGNKWLNCRYG

>NP_002418.1 collagenase 3 MMP13 UniProt_P45452 [Homo sapiens]
MHPGVLAAFLFLSWTHCRALPLPSGGDEDDLSEEDLQFAERYLRSYYHPTNLAGILKENAASSMTERLRE
MQSFFGLEVTGKLDDNTLDVMKKPRCGVPDVGEYNVFPRTLKWSKMNLTYRIVNYTPDMTHSEVEKAFKK
AFKVWSDVTPLNFTRLHDGIADIMISFGIKEHGDFYPFDGPSGLLAHAFPPGPNYGGDAHFDDDETWTSS
SKGYNLFLVAAHEFGHSLGLDHSKDPGALMFPIYTYTGKSHFMLPDDDVQGIQSLYGPGDEDPNPKHPKT
PDKCDPSLSLDAITSLRGETMIFKDRFFWRLHPQQVDAELFLTKSFWPELPNRIDAAYEHPSHDLIFIFR
GRKFWALNGYDILEGYPKKISELGLPKEVKKISAAVHFEDTGKTLLFSGNQVWRYDDTNHIMDKDYPRLI
EEDFPGIGDKVDAVYEKNGYIYFFNGPIQFEYSIWSNRIVRVMPANSILWC
```

The study on phylogenetic relationships in primates was conducted using this amino acid sequences to do the BLAST (Basic Local Alignment Search Tool) analysis in the NCBI Genebank database. The most suitable amino acid sequences for each primate species were then carefully selected from sequences delivered by the server. An out group was chosen which in our study was the Mus musculus of the order Rodentia.

The selected sequences were then compared with that of the out group and a phylogenetic tree was constructed based on the degree of divergence. The software used for constructing phylogenetic tree was Molecular Evolutionary Genetics Analysis (MEGA).

## RESULTS AND DISCUSSIONS

The research article titled "A Molecular Phylogeny of Living Primates" published in 2011, established a robust and widely accepted framework for understanding primate evolution. This phylogenetic tree served as a standard reference for our study, allowing us to compare our data and draw conclusions. According to this article Order Primata is subdivided into two major Suborder Haplorrhini and Strepsirrhini. The remaining primate phylogeny is classified as follows.

**Suborder Haplorrhini** further divides into Infraorders, namely Simiiformes and Tarsiiformes. Tarsiiforme include only one Family (Tarsiidae) with only two extant species. Simiiformes is subdivided into Parvorders Catarrhini (Old world) and Platyrrhini (New world).

Parvorder Catarrhini in turn consist of the Superfamilies Cercopithecoidea and Hominoidea. Cercopithecoidea has only one extant Family *viz*. Cercopithecidae but the organisms of Superfamily Hominoidea is further divided into two Families, *viz*, Hylobatidae and Hominidae. Family Cercopithecidae has two Subfamilies such as Cercopithecinae and Colobinae. Family Hylobatidae include all Gibbon Genus and there is no further subgrouping. Hominidae on the other hand has two Subfamilies *viz.* Homininae and Ponginae. Subfamily Ponginae include all species of Orangutang and all o there Greater Apes and Humans are included in Homininae. Subfamily Cercopithecinae is subdivided into two Tribes namely, Papionini and Cercopithecini whereas Colobinae is subdivided into two Tribes namely Presbytini and Colobini.

Parvorders Platyrrhini on the other hand is divided directly into three Families such as Cebidae, Atelidae and Pitheciidae. Family Cebidae has four Subfamilies namely, Callitrichinae, Aotinae, Cebinae and Saimirinae. Fly. Atelidae has two Subfamilies (Atelinae & Alouattinae) so also Fly. Pitheciidae (Callicebinae & Pitheciinae).

**Suborder Strepsirrhini** is divided into the Infraorders Lemuriformes, Chiromyiformes and Lorisiformes. Unlike Haplorrhini, there is no observed grouping of these Infraorders into Parvorders or Superfamilies. Instead, they are grouped into Families such as Lepilemuride,

Cheirogaleidae, Indriidae, Lemuridae, Daubentoniidae, Lorisidae and Galagidae. Further subdivision within Lorisidae includes the subfamilies Lorisinae and Perodicticinae.

**MMP-1**

The phylogenetic tree for the MMP1 gene in primates was meticulously constructed, employing an analysis of amino acid sequences from various primate species. To enhance our phylogenetic analysis, *Mus musculus* was strategically employed as the outgroup, providing a reference point for the evolutionary relationships within the MMP1 collagenase gene among primates. Our investigation also utilized a well established standard phylogenetic tree for primates, derived from genomic sequences across diverse species, serving as a foundational reference for elucidating the evolutionary dynamics of collagenase genes within our study group (Reference). The results obtained regarding the evolutionary pathway of the MMP1 gene include the following observations:

- *Carlito syrichta*: Our findings indicate that MMP1 gene of *Carlito syrichta,* a tarsier species primarily descended with minimal changes from the common ancestor of all primates indicating an ancient ancestry. Although this tree suggests such an ancient ancestry and early divergence of *Carlito syrichta* from the early primate stock, a comparison with the established tree reveals that tarsiers diverged from a common stock of strepsirrhini - more primitive primate. It is therefore inferred that the MMP1 gene remained with minimum changes in the tarsiers as compared to strepsirrhini primates.
- *Hominidae:* In our tree constructed using MMP1 the common ancestor of *Pan* and *Homo*, along with the common ancestor of *Gorilla* and *Pongo,* collectively share a common ancestor. Gibbons, including *Nomascus* and *Symphalangus,* share a common ancestor that along with the common ancestor of *Hominidae* were descended from a common stock of interbreeding ape like animal. Upon analysing the standard phylogenetic tree, a similar pattern emerges, with *Homo* and *Pan* sharing a common ancestor. This common ancestor was also ancestral to present day *Gorilla,* from which the *Pongo* ancestry might have diverged. However, the discrepancy in our results suggestive of *Gorilla* sharing a recent

common ancestor with *Pongo,* but not with *Homo* or *Pan*. This suggests a simultaneous origin for *Gorilla* and *Pongo*, contrary to the standard tree's assertion of *Gorilla*'s more recent evolution compared to *Pongo*. Further analysis of the amino acid sequences are required to see if the *Homo-Pan* group has any common advantage with the kind of changes on the MMP1 protein over the *Gorilla-Pongo* group.

- Old World Monkeys: Our results indicate that, three groups *viz. Macaca*, *Papio* and *Theropithecus* are equally distant from a common ancestor, while *Colobus* and *Trachypithecus* share another common ancestor. The standard phylogenetic tree confirms this, revealing a common ancestor for *Colobus* and *Trachypithecus,* along with the ancestor of *Macaca, Papio* and *Theropithecus.* But with *Macaca, Papio* and *Theropithecus,* our results differ from the standard tree. While standard tree implies that *Papio* and *Theropithecus* had a common ancestor after the common ancestry shared with *Macaca,* our tree do not mention between an ancestor common to both *Papio* and *Theropithecus.* Though the changes are minimal, it wold be interesting to look for the their sequences for further analysis.

- New World Monkeys: Our findings in New World Monkeys suggest that *Saimiri* and *Cebus* share a most recent common ancestor, while *Aotus* share a common ancestor with this lineage. This is consistent with both our phylogenetic tree and the standards phylogenetic tree. Furthermore, *Nycticebus* and *Otolemur* share a common ancestor, and *Lemur* and *Microcebus* also share a common ancestor. The common ancestors of these pairs collectively had a single common ancestor, aligning with observations on the standard phylogenetic tree.

**MMP-8**

- *Hominidae*: In the phylogenetic tree derived from MMP8 sequence data, it was observed that the common ancestor of Homo and Gorilla shares ancestry with the common ancestor of Pan. This collective ancestry is further linked to the common ancestor of Hominidae, which is shared with Gibbons. In contrast to the standard phylogenetic tree, where Pan and Homo share an ancestor ancestral to present-day Gorilla, our results suggest the potential existence of an alternative evolutionary pathway for these three species. A comprehensive investigation is recommended to explore the implications of this alternative pathway further.

- Loris: Our findings indicate that the Loris shares a common ancestor with Hominidae, Tarsier, Gibbons, New World, and Old World monkeys, all of which originate from the Strepsirrhini primates. Similarly, Lemurs are shown to arise from Haplorrhini primates. Discrepancies with the standard phylogenetic tree, which suggests a more recent common ancestry for Lemurs and Loris, necessitate further analysis to validate the proposed ancestral pattern among the descendants of these two major groups of early primates.

- New World Monkeys: Upon examining the lineage of New World monkeys, it is observed that recent descendants Aotus and Saimiri share a common ancestor, which is further linked to the common ancestor of Cebus and Sapajus. This lineage can be traced back to early Strepsirrhini primates. Although minor differences are noted compared to the standard phylogenetic tree, where an ancestor common to Saimiri and Cebus precedes the common ancestry with Aotus, further analysis is warranted to explore these nuances.

- Old World Monkeys: Our analysis reveals that Papio and Theropithecus share a common ancestor, which is connected to the common ancestor of Macaca. This ancestral lineage can be traced back to an ancestor shared with the common ancestor of Piliocolobus and Trachypithecus. The observed pattern aligns with the standard phylogenetic tree in the lineage of Old World monkeys.

**MMP-13**

- *Hominidae*: When we comparing the phylogenetic tree made by us on the basis of MMP13 and the standard one, the Nomascus leucogenys & Symphalongus syndactylus (Hylobatidae) share a recent common ancestor and they together share common ancestor with old world monkeys in MMP13. But, when we comparing this with the standard one we can observe that the Hylobatidae sharing common ancestor with Hominidae.

- New World Monkeys: Our findings in new world monkeys by comparing the Standard phylogenetic tree with the phylogenetic tree of MMP13 depicting that, in the phylogenetic tree of MMP13, the Cebus imitator & Sapajus apella shares a recent common ancestor and these group share a common ancestor with Samiri bolivensis and all of these collectively share a common ancestor with Aotus nancymaae. When we comparing this with the standard phylogenetic tree Cebus imitator & Samiri bolivensis directly arrived from a common ancestor.

- Old World Monkeys: By analysing the group Cercopithecidae in the tree of MMP13, Papio Anubis & Theropithecis gelada share a recent common ancestor and they together share a common ancestor with Macaca group, Piliocolobus tephrosceles & Trachypithecus francoisi directly. But when we comparing this with the standard phylogenetic tree, they where not sharing a common ancestor directly, all of them share a common ancestor with other species recently, but all of them primitively share a common ancestor.

Alignment: D:\Leyon\Evolution\MMP1\1-tree_for_seaview.txt
Seaview [blocks=10 fontsize=12 A4-landscape] on Wed Jan 31 07:26:41 2024

```
                              1
Homo_sapiens                  MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Mus_musculus                  MPSLP---LL LLLWAASSYS FPVFHNGDRQ NVETVWKYLE NYYNL---GK NMQAKNVNGK EMMAEKLRQM
Aotus_nancymaae               MHSYPP-LLL LLFWGVVSHG FPATLETQEQ DVEIVQKYLE QYYNLKNDGK QVEKKRSSGP --VVEKLKQM
Carlito_syrichta              MPSLP--LVL MLLWAVGSRG FPATSETREQ DVEIVQKYLE NYFNLKNDGK QFEKQRHSAP --VVEKLKEM
Cebus_imitator                MHSYPL-LLL LLFWGVVSHG FPATLETQEQ DVEIVQKYLE QYYNLKNDGK QVEKQRNSGP --VVEKLKQM
Gorilla_gorilla               MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Lemur_catta                   MPSFS--LLL LLLWGLGSHG FPAIPETQEQ DVEIVQKYLE NYYDLKNVGK QIEKKRSSGS --VVEKLKQM
Macaca_mulatta                MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDFVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Macaca_nemestrina             MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Microcebus_murinus            MPRFS--LLL LLLWSLGSHG LPVAPETQEQ DVEIVQKYLE NYYDLKNDGK QIEKKRNSGP --VVEKLKQM
Nomascus_leucogenys           MHSFPPLLLL LLFWSVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGL --VVEKLKQM
Nycticebus_coucang            MPSF---LLL LLLWGLGSHA FPAIPEPQEQ DVEIVQKYLE NYYDLKNDGS QIERKRNSGP --VVEKLKQM
Otolemur_garnettii            MSSFP--LLL LLLWGLGSHA LPVTPETQEQ DVEIVQKYLE NYYDLKNDGM QIERKRNSGP --VVEKLKQM
Pan_paniscus                  MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Pan_troglodytes               MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Papio_anubis                  MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Piliocolobus_tephrosceles     MHSFPPLLLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVQKQRNSGP --VVEKLKQM
Pongo_abelii                  MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Pongo_pygmaeus                MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Saimiri_boliviensis           MHSYPP-LLL LLFWSVVSHG FPATLETQEQ DVEIVQKYLE QYYDLKNDGK QVEKQRNSGP --VVEKLKQM
Sapajus_apella                MHSYPL-LLL LLFWGVVSHG FPATLETQEQ DVEIVQKYLE QYYNLKNDGK QVEKQRNSGP --VVEKLKQM
Symphalangus_syndactylus      MHSFPPLLLL LLFWSVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGL --VVEKLKQM
Theropithecus_gelada          MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Trachypithecus_francoisi      MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDRR QVEKQRNSGP --VVEKLKQM
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                             71
Homo_sapiens                 QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Mus_musculus                 QQLFGLKVTG NSDPETLRAM KKPRCGVPDV APYAITHNNP RWTKTHLTYS ILNYTPYLPK AVVEDAIARA
Aotus_nancymaae              QEFFGLKVTG KPDAETLNVM KQPRCGVPDV ARFVLTEGNP RWEKTHLTYR IENYTPDLPR ADVDQAIEKA
Carlito_syrichta             QKFFGLKVTG KPDPETLKVM KQPRCGVPDV AQFVLTEGNP RWQKTDLTYR IENYTPDLPK AEVDRAIEKA
Cebus_imitator               QEFFGLKVTG KPDAETLKVM KQPRCGVPDV ARFVLTEGNP RWKKTHLTYR IENYTPDLPR SDVDHAIEKA
Gorilla_gorilla              QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Lemur_catta                  QEFFGLKVTG KPDTETLKVM KQPRCGVPDV ARFVLTQGNP RWEQTHLTYR IENYTPDLPR ADVDLAIEKA
Macaca_mulatta               QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR AAVDQAIEKA
Macaca_nemestrina            QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR AAVDQAIEKG
Microcebus_murinus           QEFFGLKVTG KPDTETLKVM KQPRCGVPDV ARFVLTQGNP RWEKTHLTYR IENYTPDLSR ADVDHAIEKA
Nomascus_leucogenys          QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTAGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Nycticebus_coucang           QEFFGLKVTG TPDTETLKVM KQPRCGVPDV ARFALTPGNP RWEQTHLTYR IENYTPDLPR ADVDDAIEKA
Otolemur_garnettii           QEFFGLKVTG TPDTETLKVM KQPRCGVPDV ARFVLTQGNP RWEQTHLTYR IENYTPDLPK ADVDDAIEKA
Pan_paniscus                 QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIAKA
Pan_troglodytes              QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIAKA
Papio_anubis                 QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR AAVDQAIEKA
Piliocolobus_tephrosceles    QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDRAIEKA
Pongo_abelii                 QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Pongo_pygmaeus               QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Saimiri_boliviensis          QEFFGLKVTG KPDAETLNVM KQARCGVPDV ARFVLTEGNP RWEKTHLTYR IENYTPDLRR ADVDHAIEKA
Sapajus_apella               QEFFGLKVTG KPDAETLKVM KQPRCGVPDV ARFVLTEGNP RWEKTHLTYR IENYTPDLPR SDVDHAIEKA
Symphalangus_syndactylus     QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTAGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Theropithecus_gelada         QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR AAVDQAIEKA
Trachypithecus_francoisi     QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDRAIEKA
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141

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Homo_sapiens | FQLWSNVTPL | TFTKVSEGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDERWTNNF |
| Mus_musculus | FRVWSDVTPL | TFQRVFEEEG | DIVLSFHRGD | HGDNNPFDGP | NYKLAHTFQP | GPGLGGDVHY | DLDETWTNSS |
| Aotus_nancymaae | FQLWSNVTPL | TFTKVPKGQA | DIMISFVRGD | HQDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDETWTNNF |
| Carlito_syrichta | FQLWSNASPL | RFTKVVEGQA | DIMISFVRGD | HQDNSPFYGP | GENLAHAFQP | GPNIGGDAHF | DEDETWTNNI |
| Cebus_imitator | FQLWSNVTPL | TFTKVPKGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GSGIGGDAHF | DEDETWTNNF |
| Gorilla_gorilla | FQLWSNVTPL | TFTKVSEGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDERWTNNF |
| Lemur_catta | FQLWSNASPL | TFTKVFEGQA | DIMISFVRGD | HQDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDEQWTSDS |
| Macaca_mulatta | FQLWSNVTPL | TFTKVSEGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDERWTNNF |
| Macaca_nemestrina | FQLWSNVTPL | TFTKVSEGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDERWTNNF |
| Microcebus_murinus | FQLWSNASPL | TFTRVFEGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDEQWTNNF |
| Nomascus_leucogenys | FKLWSNVTPL | TFTKVSEGQA | DIMISFVRGD | HQDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDERWTNNF |
| Nycticebus_coucang | FRLWSNASPL | TFTKVFQGQA | DIMISFVRGD | HQDNSPFDGP | GGNLAHAFQP | GPGIGGDTHF | DEDERWTNNL |
| Otolemur_garnettii | FQLWSNASPL | TFTKVFQGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDEKWTNNL |
| Pan_paniscus | FQLWSNVTPL | TFTKVSEGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDERWTNNF |
| Pan_troglodytes | FQLWSNVTPL | TFTKVSEGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDERWTNNF |
| Papio_anubis | FQLWSNVTPL | TFTKVSEGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDERWTNNF |
| Piliocolobus_tephrosceles | FQLWSNVTPL | TFTKVSEGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDERWTNNF |
| Pongo_abelii | FQLWSNVTPL | TFTKVSEGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDERWTNNF |
| Pongo_pygmaeus | FQLWSNVTPL | TFTKVSEGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDERWTNNF |
| Saimiri_boliviensis | FQLWSNVTPL | TFTKVPKGQA | DIMISFVRGD | HQDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDETWTNNF |
| Sapajus_apella | FQLWSNVTPL | TFTKVPKGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDETWTNNF |
| Symphalangus_syndactylus | FKLWSDVTPL | TFTKVSEGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DDDERWTNNF |
| Theropithecus_gelada | FQLWSNVTPL | TFTKVSEGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDERWTNNF |
| Trachypithecus_francoisi | FQLWSNVTPL | TFTKVSEGQA | DIMISFVRGD | HRDNSPFDGP | GGNLAHAFQP | GPGIGGDAHF | DEDERWTNNF |

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Homo_sapiens                  REYNLHRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Mus_musculus                  ENFNLFYVTA HELGHSLGLT HSSDIGALMF PSYTWYTEDF VLNQDDINRI QDLYGPSPNP IQPTGATTPH
Aotus_nancymaae               REYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGKSQNP VQPTGPQTPQ
Carlito_syrichta              QNYNLYRVAA HEFGHSLGLS HSTDIGALMY PTYT-YSGDV QLAQDDIDGI QAIYGPSQNP IQPTGPQTPQ
Cebus_imitator                RGYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGQSPNP VQPTGPQTPQ
Gorilla_gorilla               REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Lemur_catta                   RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYT-FSGDV QLAQDDIDGI QAIYGPSQNP NQPTGPQTPQ
Macaca_mulatta                REYNLYRVAA HEFGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Macaca_nemestrina             REYNLYRVAA HELGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Microcebus_murinus            RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYA-FSGDV QLAQDDIDGI QAIYGPSQNP NQPIGPQTPQ
Nomascus_leucogenys           REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Nycticebus_coucang            RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYA-FSGEV ELAQDDIDGI QAIYGPSQNP IQPIGPQTPQ
Otolemur_garnettii            RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYA-FSGEV ELAQDDIDGI QAIYGPSQNP VQPTGPQTPQ
Pan_paniscus                  REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGHSQNP VQPIGPQTPK
Pan_troglodytes               REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Papio_anubis                  REYNLYRVAA HELGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Piliocolobus_tephrosceles     REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLSQDDIDGI QAIYGGSQNP VQPTGPQTPK
Pongo_abelii                  REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGPSQNP VQPIGPQTPK
Pongo_pygmaeus                REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGPSQNP VQPIGPQTPK
Saimiri_boliviensis           REYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGPSPNP VQPTGPQTPQ
Sapajus_apella                REYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGQSPNP VQPTGPQTPQ
Symphalangus_syndactylus      REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Theropithecus_gelada          REYNLYRVAA HELGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Trachypithecus_francoisi      REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
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                              281
Homo_sapiens                  ACDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Mus_musculus                  PCNGDLTFDA ITTFRGEVFF FKGRFYIRVN RFMPEPELNL IGILWPNLPV KLDAAYEASM IDQVRYFKGS
Aotus_nancymaae               VCDSKLTFDA ITTIRGEVFF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Carlito_syrichta              ACDSKISFDA VTTIRGEVMF FKDRFFMRTH PSYPEADLNF ISDFWPLLPN GLEAAYEDAG RDQVRFFKGY
Cebus_imitator                VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PYYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Gorilla_gorilla               VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLQAAYEFAD RDEVRFFKGN
Lemur_catta                   VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPS GLEAAYEVAS RDEVRFFKGN
Macaca_mulatta                VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Macaca_nemestrina             VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Microcebus_murinus            VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF VSVFWPQLPT GLEAAYEVAD RDEVRFFKGN
Nomascus_leucogenys           VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Nycticebus_coucang            VCDSKLTFDA VTTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPS GLEAAYEVVD RDEIRFFKGN
Otolemur_garnettii            VCDSKLTFDA VTTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEVAD RDEVRFFKGN
Pan_paniscus                  VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PSYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Pan_troglodytes               VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Papio_anubis                  VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Piliocolobus_tephrosceles     VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLQAAYEFAE RDEVRFFKGN
Pongo_abelii                  VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Pongo_pygmaeus                VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Saimiri_boliviensis           VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Sapajus_apella                VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PYYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Symphalangus_syndactylus      VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGK
Theropithecus_gelada          VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Trachypithecus_francoisi      VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLQAAYEFAD RDEVRFFKGN
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                              351
Homo_sapiens                  KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Mus_musculus                  KVWAVQEQSV LRGFPRDIHS FFGFPSNVTH IDAAVCEEET GKTYFFVDHM YWRYDENTQS MDPGYPRLTA
Aotus_nancymaae               KYWAAQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDAGYPKMIA
Carlito_syrichta              RFWAVQGQDV LRGYPQDIYS SYGFPRTVKH IDAAVFEEET GKTFFFVGNK YWRYDEYKRS MDVGYPKMIA
Cebus_imitator                KYWAVQGQNV LYGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDAGYPKKIA
Gorilla_gorilla               KYWAVQGQNM LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDPGYPKMIA
Lemur_catta                   KYWAVQGQNV LPGYPKDIYR SFGFPRTVKH IDAAISEEDT GKTYFFVANK YWRYDEYKQS MDTGYPKKLA
Macaca_mulatta                KYWAVQGQNV LPGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Macaca_nemestrina             KYWAVQGQNV LPGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Microcebus_murinus            KYWAVQGQNV LPGYPKDIYK SFGFPKTVKH IDAAVSEEDT GKTYFFVANK YWRYDEYKQS MDAGYPKMIA
Nomascus_leucogenys           KYWAVQGQNV LHGYPKDIYS SFGFPRTVKR INAALSEENT GKTYFFVAKK YWRYDEYKRS MDPGYPKMIA
Nycticebus_coucang            KYWAVRGQDV LHGYPKDISS SFGFPRTVKH VDAAVSEEET GKTYFFVANK YWRYDENKQS MDTGYPKMIA
Otolemur_garnettii            KYWAVRGPDV LHGYPKDISS SFGFPRTVKH VDAAVSEEET GKTYFFVANK YWRYDENKQS MDTGYPKTIA
Pan_paniscus                  KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Pan_troglodytes               KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Papio_anubis                  KYWAVQGQNV LPGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIS
Piliocolobus_tephrosceles     KYWAVQGQNV LRGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Pongo_abelii                  KYWAVQGQNM LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEHKRS MDPGYPKMIA
Pongo_pygmaeus                KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Saimiri_boliviensis           KYWAVQGQNV LYGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDAGYPKMIA
Sapajus_apella                KYWAVQGQNV LYGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDAGYPKKIA
Symphalangus_syndactylus      KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVAKK YWRYDEYKRS MDPGYPKMIA
Theropithecus_gelada          KYWAVQGQNV LPGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK CWRYDEYKRS MDPGYPKMIA
Trachypithecus_francoisi      KYWAVQGQNV LRGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYERS MDPGYPKMIA
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Homo_sapiens                  HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Mus_musculus                  EDFPGIDDKV DDVFQKGENF YFFHQSVQHR FNLQIRRVDD SRDSSTWFNC ---
Aotus_nancymaae               DDFPGIGHKV DAVFMKDGFF YFFHKTRQYK FEPETKRILT LQKANSWFNC RKN
Carlito_syrichta              HGFPGIGHKV DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKN
Cebus_imitator                HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Gorilla_gorilla               HDFPGIGHKV DAVFMKDGFF YFFRGRRQYK FDPETKRILT LQKANSWFNC RKN
Lemur_catta                   LDFPGIGHKI DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKK
Macaca_mulatta                HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Macaca_nemestrina             HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Microcebus_murinus            HDFPGIGHKI DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKN
Nomascus_leucogenys           HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Nycticebus_coucang            HDFPGIGHKV DAVFKKDEFF YFFHGTRQYK FDLKTKRILT LLKANSWFNC RKH
Otolemur_garnettii            HDFPGIGHKV DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKH
Pan_paniscus                  HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Pan_troglodytes               HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Papio_anubis                  HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Piliocolobus_tephrosceles     HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Pongo_abelii                  HDFPGIGHKV DAVFTKDGFF YFFHGTRQYK FDPETKRILT LQKANSWFNC RKN
Pongo_pygmaeus                HDFPGIGHKV DAVFTKDGFF YFFHGTRQYK FDPETKRILT LQKANSWFNC RKN
Saimiri_boliviensis           HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Sapajus_apella                HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Symphalangus_syndactylus      HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Theropithecus_gelada          HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Trachypithecus_francoisi      HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
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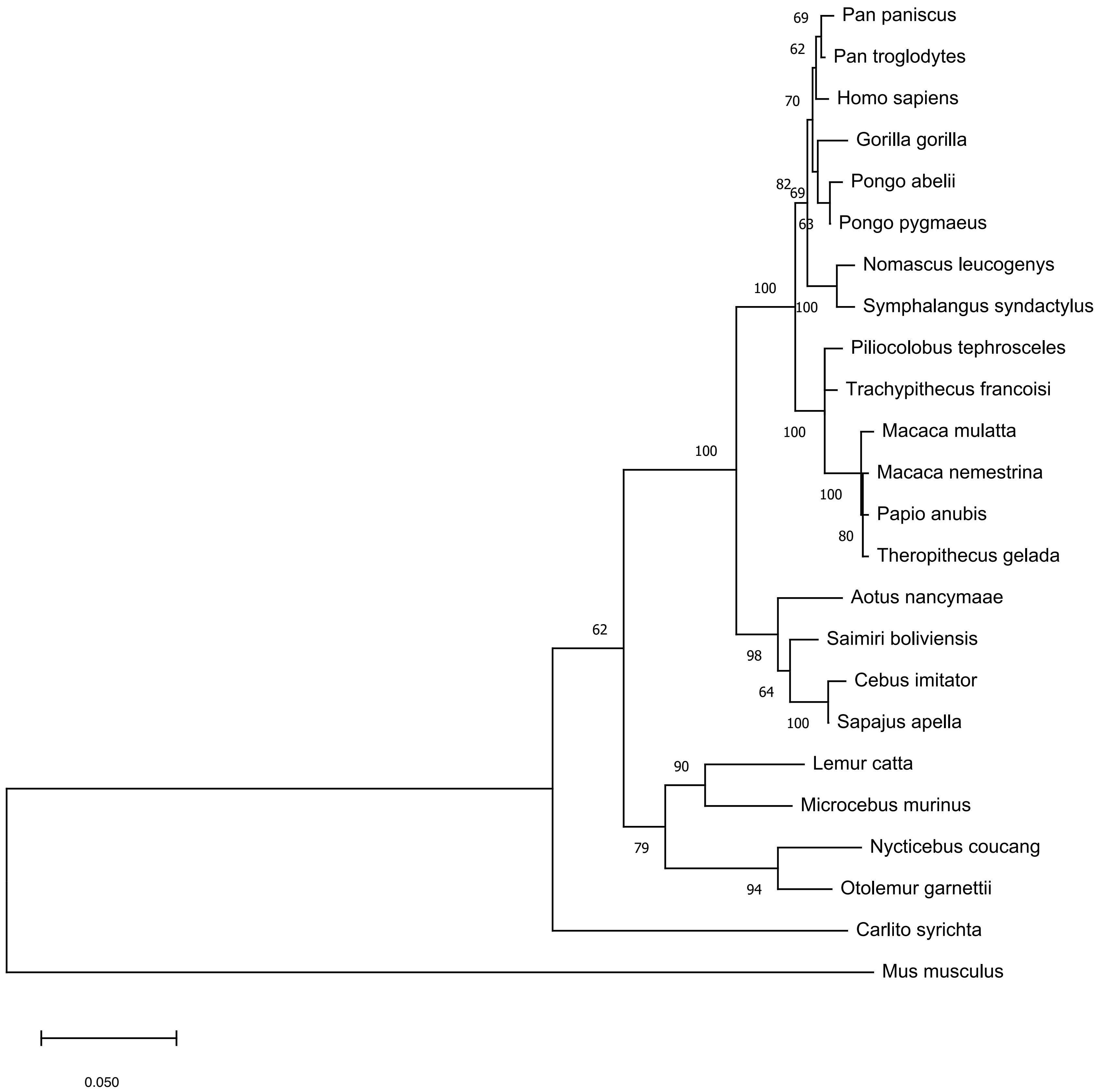
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Pan troglodytes
Homo sapiens
Gorilla gorilla
Pongo abelii
Pongo pygmaeus
Nomascus leucogenys
Symphalangus syndactylus
Piliocolobus tephrosceles
Trachypithecus francoisi
Macaca mulatta
Macaca nemestrina
Papio anubis
Theropithecus gelada
Aotus nancymaae
Saimiri boliviensis
Cebus imitator
Sapajus apella
Lemur catta
Microcebus murinus
Nycticebus coucang
Otolemur garnettii
Carlito syrichta
Mus musculus
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                              1
Homo_sapiens                  MFSLKTLPFL LLLHVQISKA FPVSS--KEK NTKTVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Mus_musculus                  MFRLKTLPLL IFLHTQLANA FPVPEHLEEK NIKTAE---- -------NYLR KFYNLPSNQF RSSRN--ATM
Aotus_nancymaae               MFCLKTLPFL LLLHVQISKA FPVSS--KEK DTKIVQ---- -------DYLE KFYQLPSNQY QSIRKNSINM
Carlito_syrichta              MFSLQMLLFL LLLHMQVATA FPTPS--EEK STTMVQ---- -------DYLE KFYQLPSSRY RSARKNSTSM
Cebus_imitator                MFCLKTLPFL LLLHVQISKA FPVSS--KEK DTKIVQ---- -------DYLE KFYQLPSNQH QSIRKNSINM
Gorilla_gorilla               MFSLKTLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Lemur_catta                   MFYLKTLPFL LLLHMELSKA FPVPS--EEK NAKIVQ---- -------DYLE KFYRLPSNQY RTARKNSPST
Macaca_mulatta                MFSLKMLLFL LLLHVQISKA FPVSS--KEE NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTSM
Macaca_nemestrina             ---------- -------MQQ IP-------- QEKSIN---- -------DYLE KFYQLPSNQY QSTRKNGTSM
Microcebus_murinus            MFCLKTLPLL LLLHMELSKA FPVPS--EGR NAKIVQ---- -------DYLE KFYRLPSNQY RTARKNSASM
Nomascus_leucogenys           MFALKTLPFL LLLHVHISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Nycticebus_coucang            MFCLKTLLFL LLLHVQLSKT FPVVS--AEK NTKLIQ---- -------DYLE KFYQLPSNRY RTSRKNSTTM
Otolemur_garnettii            MFRLKTLVFL LLLHVPLSKT FPVVS--AEK NTKLIQ---- -------DYLE KFYQLPSNRY RTSRKNSTTM
Pan_paniscus                  MFSLKTLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Pan_troglodytes               MFSLKMLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Papio_anubis                  MFSLKMLPFL LLLHVQISKA FPVSS--KEE NTKIVQ---- -------DYLE KFYQLPSNQY QSMRKNGTSM
Piliocolobus_tephrosceles     MFSLKTLPFL FLLHVQISKA FPVSS--KEE NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTSM
Pongo_abelii                  MFSLKTLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Pongo_pygmaeus                -MCRFPRPFL YLLKRKIQKL FSTRP--SQK PTRCSHLILD FPASKIDYLE KFYQLPSNQY QSTRKNGTNV
Saimiri_boliviensis           MFCLKRLPFL LLLHVQISKA FPVSF--KEK DTKIVQ---- -------DYLE KFYQLPSNQY QSIRKNSINM
Sapajus_apella                MFCLKTLPFL LLLHVQISKA FPVSS--KEK DTKIVQ---- -------DYLE KFYQLPSNQY QSIRKNSINM
Symphalangus_syndactylus      MFALKTLPFL LLLHVHISKA FPVSS--KEK NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTNV
Theropithecus_gelada          MFSLKMLPFL LLLHVQISKA FPVSS--KEE NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTSM
Trachypithecus_francoisi      MFSLKTLPFL LLLHVQISKA FPLSS--KEE NTKIVQ---- -------DYLE KFYQLPSNQY QSTRKNGTSM
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                             71
Homo_sapiens                 IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGG FMLTPGNPKW ERTNLTYRIR NYTPQLSEAE
Mus_musculus                 VAEKLKEMQR FFSLAETGKL DAATMGIMEM PRCGVPDSGD FLLTPGSPKW THTNLTYRII NHTPQLSRAE
Aotus_nancymaae              IVEKLKEMQR FFGLNVTGKP NAETLEMMKQ PRCGVPDSGD FMITPGNPKW EQTNLTYRII NYTPQLSETE
Carlito_syrichta             IVEKLKEMQR FFGLNVTGKP DAETLETMEK PRCGVPDRGD FMLTPGNPKW KHTNLTYRII NYTPQLSEAD
Cebus_imitator               IVEKLKEMQQ FFGLNVTGKP NAETLEMMKQ PRCGVPDSGD FMITPGNPKW EQTNLTYRII NYTPQLSETE
Gorilla_gorilla              IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGG FMLTPGNPKW EHTNLTYRIR NYTPQLSVAE
Lemur_catta                  IVEKLKEMQR FFRLNVTGKP DAETLEVMEK PRCGVPDSGD FAITPGNPKW EHTNLTYRII SYTQQLSEAD
Macaca_mulatta               IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMLTPGNPKW ERTNLTYSIL NYTPQLSETD
Macaca_nemestrina            IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMLTPGNPKW ERTNLTYSIL NYTPQLSETD
Microcebus_murinus           VVEKLKEMQR FFGLNVTGKP DAETLEVMEK PRCGVPDSSS FMITPGSPKW EHTNVTYRII SHTQQLSVAE
Nomascus_leucogenys          IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMITPGNPKW ERTNLTYRIR NYTPQLSKAD
Nycticebus_coucang           IVEKLKEMQR FFGLNVTGKP NAETLEMMEK PRCGVPDTAG FVLTPGNPKW EHINLTYRFI NYTPQLSKTD
Otolemur_garnettii           IVEKLKEMQR FFGLNVTGKP NAETLEMMEK PRCGVPDTAG FMLTPGSPKW EHTNLTYRFI NYTPQLSKTD
Pan_paniscus                 IIEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGG FMLTPGNPKW ERTNLTYRIR NYTPQLSEAE
Pan_troglodytes              IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGG FMLTPGNPKW EHTNLTYRIR NYTPQLSEAE
Papio_anubis                 IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMLTPGNPKW EHTNLTYRIL NYTPQLSETD
Piliocolobus_tephrosceles    IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDTGD FMLTPGNPKW KHTNLTYSIL NYTPQLSQTD
Pongo_abelii                 IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGE FMLTPGNPKW ERTNLTYRIR NYTPQLSEDD
Pongo_pygmaeus               IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGE FMLTPGNPKW ERTNLTYRIR NYTPQLSEDD
Saimiri_boliviensis          IVEKLKEMQR FFGLNVTGKP DAETLEMMKQ PRCGVPDSGD FMITPGNPKW EQTNLTYRFI NYTPQLSVTE
Sapajus_apella               IVEKLKEMQQ FFGLNVTGKP NAETLEMMKQ PRCGVPDSGD FMITPGNPKW EQTNLTYRII NYTPQLSETE
Symphalangus_syndactylus     IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMITPGNPKW ERTNLTYRIR NYTPQLSKTD
Theropithecus_gelada         IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMLTPGNPKW ERTNLTYRIL NYTPQLSETD
Trachypithecus_francoisi     IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDTGD FMLTPGNPKW KHTNLTYSIL NYTPQLSKTD
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                              141
Homo_sapiens                  VERAIKDAFE LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Mus_musculus                  VKTAIEKAFH VWSVASPLTF TEILQGEADI NIAFVSRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDS
Aotus_nancymaae               VETAIGNAFK VWSNASSLTF TRISQGEANI SIAFFHRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDA
Carlito_syrichta              VDSAIERAFE LWSHASPLRF TRISQGEPDI KIAFVQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Cebus_imitator                VERAIGDAFK VWSDVSPLTF TRISQGEADI NIAFYQKDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Gorilla_gorilla               VERAIKDAFE LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Lemur_catta                   VETAIEKAFK VWSDVSPLTF TRISRGEADI KIAFYLRDHG DNSPFDGPNG ILAHAFQPGR GIGGDVHFDA
Macaca_mulatta                VEGAIKKAFE VWSKASPLTF TRISQGQADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Macaca_nemestrina             VEGAIKKAFE VWSKASPLTF TRISQGQADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Microcebus_murinus            VGAAFEKAFK LWSGASPLTF TRISQGEADI KIAFVQRDHG DNSPFDGPNG ILAHAFQPGP GIGGDVHFDA
Nomascus_leucogenys           VERAIEKAFK VWSDASPLTF TRISQGEADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Nycticebus_coucang            VETVIEKAFE VWSKASPLTF TKISQGEADI KIAFVRREHG DNSPFDGPNG ILAHAFQPGR GIGGDVHFDE
Otolemur_garnettii            VETVIEKAFE VWSKASPLTF TKTAQGEADI KIAFVQKDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDE
Pan_paniscus                  VERAIKDAFK LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Pan_troglodytes               VERAIKDAFE LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Papio_anubis                  VEGAIKKAFE VWSKASPLTF TRISQGQADI NIGFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Piliocolobus_tephrosceles     VEGTIKKAFE VWSKVSPLTF TRISQGDADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Pongo_abelii                  VKTAIEKAFE VWSKASPLTF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDA
Pongo_pygmaeus                VKTAIEKAFE VWSKASPLTF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDA
Saimiri_boliviensis           VETAIGNAFK IWSDPSPLTF TRISQGEADI NIAFFPRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Sapajus_apella                VETAIGDAFK VWSDVSPLTF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Symphalangus_syndactylus      VERAIEKAFK VWSDASPLTF TRISQGEADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Theropithecus_gelada          VEGAIKKAFE VWSKASPLTF TRISQGQADI NIGFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Trachypithecus_francoisi      IEGAIKKAFE VWSKVSPLTF TRISQGEADI NIGFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
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                            211
Homo_sapiens                EETWTNTSAN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDIDGIQ AIYGLSSNPI
Mus_musculus                EETWTQDSKN YNLFLVAAHE FGHSLGLSHS TDPGALMYPN YAYREPSTYS LPQDDINGIQ TIYGPSDNPI
Aotus_nancymaae             EETWTSTSKN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYS LPQDDINGIQ AIYGPSSNPI
Carlito_syrichta            EETWTKTSAN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYL LPQDDINGIQ AIYGPSDNPI
Cebus_imitator              EETWTNTSEN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYS LPQDDINGIQ AIYGPSSNPI
Gorilla_gorilla             EETWTNTSAS YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDIDGIQ AIYGLSSNPI
Lemur_catta                 EETWTTNANN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFREPSTYT LPQDDINGIQ AIYGPSSNPV
Macaca_mulatta              EETWTKTSTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Macaca_nemestrina           EETWTKNSTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Microcebus_murinus          EETWTTNFNN YNLFLVAAHE FGHSLGLAHS SDAGALMYPN YAFSEPSTYT LPQDDINGIQ AIYGPSNNPI
Nomascus_leucogenys         EETWTKTSTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSTYS LPQDDIDGIQ AIYGPSSNPI
Nycticebus_coucang          EETWTTTAVN YNLFLVAAHE FGHSLGLSHS TDPGALMYPN YAFNDPSTYS LPQDDINGIQ AIYGPSSSPV
Otolemur_garnettii          EETWTTTSIN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFNEPSTYS LPQDDINGIQ AIYGPSNSPV
Pan_paniscus                EETWTDTSAN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDIDGIQ AIYGLSSNPI
Pan_troglodytes             EETWTDTSAN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDIDGIQ AIYGLSSNPI
Papio_anubis                EETWTKDFTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Piliocolobus_tephrosceles   EETWTTNSTN YNLFLVAAHE FGHSLGLAHS FDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Pongo_abelii                EETWTKTSAN YNLFIVAAHE FGHSLGLAHS SDPGALMYPN YAFTETSNYS LPQDDIDGIQ AIYGPSSNPV
Pongo_pygmaeus              EETWTKTSAN YNLFIVAAHE FGHSLGLAHS SDPGALMYPN YAFTETSNYS LPQDDIDGIQ AIYGPSSNPV
Saimiri_boliviensis         EETWTSTSEN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYS LPQDDINGIQ AIYGPSSNPI
Sapajus_apella              EETWTNTPEN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYS LPQDDINGIQ AIYGPSSNPI
Symphalangus_syndactylus    EETWTKTSAN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSTYS LPQDDIDGIQ AIYGPSSNPI
Theropithecus_gelada        EETWTKDFTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Trachypithecus_francoisi    EETWTTNSTN YNLFLVAAHE FGHSLGLAHS FDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
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                           281
Homo_sapiens               QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Mus_musculus               QPTGPSTPKA CDPHLRFDAT TTLRGEIYFF KDKYFWRRHP QLRTVDLNFI SLFWPFLPNG LQAAYEDFDR
Aotus_nancymaae            QPTGPSTPRP CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Carlito_syrichta           QPTGPSTPRT CDPRLTFDAI TTLRGEIFFF RDKYFWRRHP QLRSIEFNFI SLFWPALPDS IQAAYEDLDR
Cebus_imitator             QPTGPSTPRP CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Gorilla_gorilla            QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Lemur_catta                QPTGPSTPRS CDPRLTFDAI TTLRGEILFF KDKYFWRRHP QLRSVELNFI SLFWPNLPNG IQAAYEDFDR
Macaca_mulatta             QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Macaca_nemestrina          QPTGPTTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Microcebus_murinus         QPTGPSTPMA CDPRLTFDAI TTLRGEIFFF KDKYFWRRHP QLRSVELNFI SLFWPSLPNG IQAAYEDFDK
Nomascus_leucogenys        QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDSDR
Nycticebus_coucang         QPTGPSTPRT CDPRLTFDAI TTLRGEILFF KDKYFWRKHP QLPTVELNFI SLFWPSLPNG IQAAYEDFDR
Otolemur_garnettii         QPTGPSTPRT CDPRLTFDAI TTLRGEILFF KDKYFWRKHP QLPTAELNFI SLFWPSLPNG IQAAYEDFER
Pan_paniscus               QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Pan_troglodytes            QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Papio_anubis               QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Piliocolobus_tephrosceles  QPTGPSTPES CDPRLTFDAI TTLRGEILFF KDEYFWRRHP WLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Pongo_abelii               QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRIEMNFI SLFWPSLPTG MQAAYEDFDR
Pongo_pygmaeus             QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRIEMNFI SLFWPSLPTG MQAAYEDFDR
Saimiri_boliviensis        QPTGPSTPRS CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLRRVEMNFI SLFWPSLPTG IQAAYEDFDR
Sapajus_apella             QPTGPSTPRP CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Symphalangus_syndactylus   QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Theropithecus_gelada       QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Trachypithecus_francoisi   QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
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| | 351 | | | | | | |
|---|---|---|---|---|---|---|---|
| Homo_sapiens | DLIFLFKGNQ | YWALSGYDIL | QGYPKDISNY | GFPSSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQFMEPG |
| Mus_musculus | DLVFLFKGRQ | YWALSGYDLQ | QGYPRDISNY | GFPRSVQAID | AAVSYNGKTY | FFINNQCWRY | DNQRRSMDPG |
| Aotus_nancymaae | DLVFLFKGNQ | YWALSGYDIQ | QGYPRDISNY | GFPSSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQFMEPG |
| Carlito_syrichta | DLVFLFKGNQ | YWAMNGYDLQ | PGYPRDISNY | GFPSNVQAID | AAVYFRSKTY | FFVNDQFWRY | DNERQTMEPG |
| Cebus_imitator | DLVFLFKGNQ | YWALSGYDIQ | QGYPRDISNY | GFPSSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQLMEPG |
| Gorilla_gorilla | DLIFLFKGNQ | YWALSGYDIL | QGYPKDISNY | GFPSSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQFMEPG |
| Lemur_catta | DLVFLFKGNQ | YWALSGYDIQ | QGYPRYISNY | GFPSTVQAID | AAVSYGSETY | FFVNDQFWRY | DNQRQAMDPG |
| Macaca_mulatta | DLIFLFKGNQ | YWAVSGYDIQ | QGYPRDISNY | GFPSSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQFMEPG |
| Macaca_nemestrina | DLIFLFKGNQ | YWAVSGYDIQ | QGYPRDISNY | GFPSSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQFMEPG |
| Microcebus_murinus | DLVFLFKGNQ | YWAMSGYDIQ | QGYPRHISNY | GFPSNVQAID | AAVSYGRKTY | FFVNDQLWRY | DNQRQAMDPG |
| Nomascus_leucogenys | DLIFLFKGNQ | YWALSGYDIQ | QGYPKSISNY | GFPCSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQFMEPG |
| Nycticebus_coucang | DLVFLFKGNQ | YWALNGYDIQ | EGYPRDISNY | GFPSTVQAID | AAVSYRRKTY | FFVNDQFWRY | DNQRQLMEPG |
| Otolemur_garnettii | DLVFLFKGNQ | YWALNGYEIQ | QGYPRDISNY | GFPSTVQAVD | AAVFYRRKTY | FFVNDQFWRY | DNQRQFMEPG |
| Pan_paniscus | DLIFLFKGNQ | YWALSGYDIL | QGYPKDIANY | GFPSSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQFMEPG |
| Pan_troglodytes | DLIFLFKGNQ | YWALSGYDIL | QGYPKDIANY | GFPSSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQFMEPG |
| Papio_anubis | DLIFLFKGNQ | YWAVSGYDIQ | QGYPRDISNY | GFPSSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQFMEPG |
| Piliocolobus_tephrosceles | DLIFLFKGNQ | YWAVSGYDIQ | QGYPRDISNY | GFPSSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQFMEPG |
| Pongo_abelii | DLIFLFKGNQ | YWALSGYDIL | QGYPKNISNY | GFPSSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQFMEPG |
| Pongo_pygmaeus | DLIFLFKGNQ | YWALSGYDIL | QGYPKNISNY | GFPSSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQFMEPG |
| Saimiri_boliviensis | DLVFLFKGNQ | YWALSGYDIQ | QGYPRDISNY | GFPSSVQAID | AAVFYKSKTY | FFVNDQFWRY | DNQRQFMEPG |
| Sapajus_apella | DLVFLFKGNQ | YWALSGYDIQ | QGYPRDISNY | GFPSSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQLMEPG |
| Symphalangus_syndactylus | DLIFLFKGNQ | YWALSGYDIQ | QGYPKSISNY | GFPCSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQFMEPG |
| Theropithecus_gelada | DLIFLFKGNQ | YWAVSGYDIQ | QGYPRDISNY | GFPSSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQFMEPG |
| Trachypithecus_francoisi | DLIFLFKGNQ | YWAVSGYDIQ | QGYPRDISNY | GFPSSVQAID | AAVFYRSKTY | FFVNDQFWRY | DNQRQFMEPG |

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                            421
Homo_sapiens                YPKSISGAFP GIESKVDAVF QQEHFFHVFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Mus_musculus                YPKSIPSMFP GVNCRVDAVF LQDSFFLFFS GPQYFAFNFV SHRVTRVARS NLWLNCS--
Aotus_nancymaae             YPQSISYIFP GIESKVDAVF QQEHFFLFFS GPLYYAFDLS AQRVTRVARG NKWLNCR--
Carlito_syrichta            YPKSTLSIFP GIESKVDAVF QQNYFFFFFS GPRFYAFDLQ AHRVTRVDRS NRWLNCR--
Cebus_imitator              YPQRISDIFP GIERKVDAVF QQEHFFLFFS GPIYYAFDLS AQRVTRVARG NKWLNCR--
Gorilla_gorilla             YPKSISGAFP GIESKVDAVF QQQHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Lemur_catta                 YPQSILRTFP GIQSKVDAVF QKDDFFLFFS GPLYYAFNLS TRRVTRIDRS NKWLNCR--
Macaca_mulatta              YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Macaca_nemestrina           YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Microcebus_murinus          YPQSISSTFP GIQSRVDAVF QQDDFFLFFS GPRYYAFNLS TNRVTRLDKS NKWLNCR--
Nomascus_leucogenys         YPKSISGTFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVERG NKWLNCRYG
Nycticebus_coucang          YPKSLSTAFP GIESRVDAVF QRDYVFLFFS GPRYYAFDLN TRRVIRIDRS NIWLNCR--
Otolemur_garnettii          YPKSISTAFP GIESRVDAVF HRDYVFVFFS GPRYYAFDLN TRRVIRIDRS NKWLNCR--
Pan_paniscus                YPKSISGAFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Pan_troglodytes             YPKSISGAFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Papio_anubis                YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Piliocolobus_tephrosceles   YPKSTSGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTTVARA NEWLNCRYS
Pongo_abelii                YPKSISDTFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Pongo_pygmaeus              YPKSISDTFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCR--
Saimiri_boliviensis         YPQSISGIFP GIESKVDAVF QQEHFFLFFS GPIYYAFDLS AQRVTKIARG NKWLNCR--
Sapajus_apella              YPQRISDIFP GIERKVDAVF QQEHFFLFFS GPIYYAFDLS AQRVTRVARG NKWLNCR--
Symphalangus_syndactylus    YPKSISDTFP GIESKVDAVF QQERFFLFFS GPRYYAFDLI AQRVTRVERG NKWLNCRYG
Theropithecus_gelada        YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Trachypithecus_francoisi    YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
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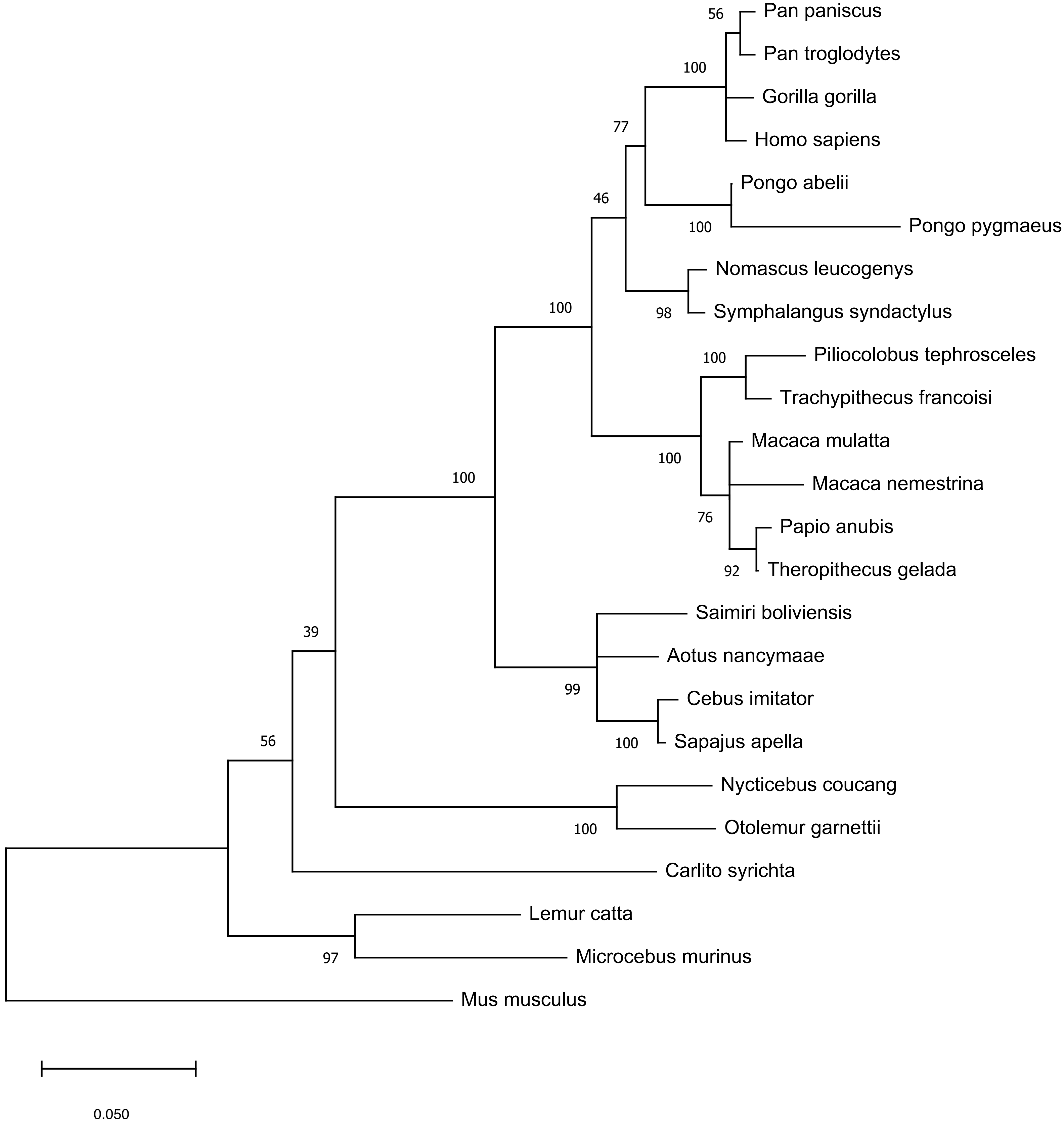
Pan paniscus
Pan troglodytes
Gorilla gorilla
Homo sapiens
Pongo abelii
Pongo pygmaeus
Nomascus leucogenys
Symphalangus syndactylus
Piliocolobus tephrosceles
Trachypithecus francoisi
Macaca mulatta
Macaca nemestrina
Papio anubis
Theropithecus gelada
Saimiri boliviensis
Aotus nancymaae
Cebus imitator
Sapajus apella
Nycticebus coucang
Otolemur garnettii
Carlito syrichta
Lemur catta
Microcebus murinus
Mus musculus
56
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Homo_sapiens               MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTERLR
Mus_musculus               MHSAILATFF LLSWTPCWSL PLPYGDDDDD DLSEEDLVFA EHYLKSYYHP ATLAGILKKS TVTSTVDRLR
Aotus_nancymaae            MHLGVLAAFL FLNWTHCRAL PLPNG-DDED DLSEEDLQFA ERYLKLYYHP TNLAGILKKN SANSMADRLR
Carlito_syrichta           MHPGVLTAFL LLCWTQCQSL PLPNG-EDED DTSEEDLQFA ERYLRSFYHP VNLAGILKKN AASSMVDRLR
Cebus_imitator             MHPGVLAAFL FLSWTHCWAL PLPNG-DDED DLSEEDLQFA ERYLKLYYHP TNLAGILKKN SASSMTDRLR
Gorilla_gorilla            MHPGVLAAFL FLSWTHSRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Lemur_catta                MHPGILVAFL FLSWTHCRSL PLPNG--DDD DLSEEDLQFA ERYLKSYYHP PNLAGILKET SASSMVDRLR
Macaca_mulatta             MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Macaca_nemestrina          MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Microcebus_murinus         -MQGVLVAFL FLSWTHCRSL PLPDG--DDD DLSEEDLQFA ERYLKSYYHP PILAGILKKT SASSMVDRLR
Nomascus_leucogenys        MHPGILAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Nycticebus_coucang         MLPGVLLAFL FLSWTHCRAL PLPND-DDDD DLSEEDLQFA ERYLKSYYYP PNLAGILKKT SASSMIDRLR
Otolemur_garnettii         MLPRVLLAFL FLSWTPCRAL PLPNG--DDD DLSEEDLQFA EHYLKSYYHP LNLAGILKKT SASSMIDRLR
Pan_paniscus               MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTERLR
Pan_troglodytes            MHPGVLAAFL FLSWAHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTERLR
Papio_anubis               MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Piliocolobus_tephrosceles  MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Pongo_abelii               MHPGVLAAFL FLSWTHCRAL PLPSD-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Pongo_pygmaeus             MHPGVLAAFL FLSWTHCRAL PLPSD-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Saimiri_boliviensis        MHPGVLAAFL FLSWTHCRAL PLPNG-DDED DLSEEDLQFA ERYLKLYYHP TNLAGILKKN SASSMTDRLR
Sapajus_apella             MHPGVLAAFL FLSWTHCWAL PLPNG-DDED DLSEEDLQFA EHYLKLYYHP TNLAGILKKN SASSMTDRLR
Symphalangus_syndactylus   MHPGILAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Theropithecus_gelada       MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Trachypithecus_francoisi   MHPVVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
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|---|---|---|---|---|---|---|---|
| | 71 | | | | | | |
| Homo_sapiens | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Mus_musculus | EMQSFFGLEV | TGKLDDPTLD | IMRKPRCGVP | DVGEYNVFPR | TLKWSQTNLT | YRIVNYTPDM | SHSEVEKAFR |
| Aotus_nancymaae | EMQSFFGLEV | TGKLDDNTLD | IMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Carlito_syrichta | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIENYTPDM | PHSEVEKAFK |
| Cebus_imitator | EMQSFFGLEV | TGKLDDNTLD | IMKKPRCGVP | DVGEYNVFPR | TLKWPKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Gorilla_gorilla | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Lemur_catta | EMQSFFGLEV | TGKLDDNTLD | IMKKPRCGVP | DVGEYNVFPR | TLKWTQTNLT | YRIVNYTPDM | PHSEVEKAFK |
| Macaca_mulatta | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Macaca_nemestrina | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Microcebus_murinus | EMQSFFGLEV | TGKLDDNTLD | IMKKPRCGVP | DVGEYNVFPR | TLKWTQTNLT | YRIVNYTPDM | THSEVEKAFK |
| Nomascus_leucogenys | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Nycticebus_coucang | EMQSFFGLEV | TGKLDDNTLD | IMKKPRCGVP | DVGEYNVFPR | TLKWTKTNLT | YRIVNYTPDM | THSEVEKAFK |
| Otolemur_garnettii | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWTKTNLT | YRIVNYTPDM | THSEVEKAFK |
| Pan_paniscus | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Pan_troglodytes | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Papio_anubis | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Piliocolobus_tephrosceles | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Pongo_abelii | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Pongo_pygmaeus | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Saimiri_boliviensis | EMQSFFGLEV | TGKLDDNTLD | IMKKPRCGVP | DVGEYNVFPR | TLKWSRMNLT | YRIVNYTPDM | THSEVEKAFK |
| Sapajus_apella | EMQSFFGLEV | TGKLDDNTLD | IMKKPRCGVP | DVGEYNVFPR | TLKWPKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Symphalangus_syndactylus | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Theropithecus_gelada | EMQSFFGLEV | TGKLDDNTLD | VMKKPRCGVP | DVGEYNVFPR | TLKWSKMNLT | YRIVNYTPDM | THSEVEKAFK |
| Trachypithecus_francoisi | EMQSFFGLEV | TGKLDDNTLD | IMKKPRCGVP | DVGEYNVFPR | TLKWSKVNLT | YRIVNYTPDM | THSEVEKAFK |

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Homo_sapiens                KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Mus_musculus                KAFKVWSDVT PLNFTRIYDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Aotus_nancymaae             KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Carlito_syrichta            KAFKVWSDVT PLNFTRMHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Cebus_imitator              KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Gorilla_gorilla             KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Lemur_catta                 KAFKVWSDVT PLNFTRLHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Macaca_mulatta              KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Macaca_nemestrina           KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Microcebus_murinus          KAFKVWSDVT PLNFTRLHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNLGGDA HFDDDETWTS
Nomascus_leucogenys         KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Nycticebus_coucang          KAFKVWSDVT PLNFTRLHDG TADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Otolemur_garnettii          KAFKVWADVT PLNFTRLHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pan_paniscus                KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pan_troglodytes             KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Papio_anubis                KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Piliocolobus_tephrosceles   KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pongo_abelii                KAFKVWSDVT PLNFTRLHNG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pongo_pygmaeus              KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Saimiri_boliviensis         KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Sapajus_apella              KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Symphalangus_syndactylus    KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Theropithecus_gelada        KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Trachypithecus_francoisi    KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
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Homo_sapiens                  SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Mus_musculus                  SSKGYNLFIV AAHELGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQFLYGPG DEDPNPKHPK
Aotus_nancymaae               SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQFLYGPG DEDPNPKHPK
Carlito_syrichta              SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK NHFVLPDDDV QGIQTLYGPG DEDPNPKHPK
Cebus_imitator                SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTSK SHFMLPDDDV QGIQFLYGPG DEDPNPKHPK
Gorilla_gorilla               SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Lemur_catta                   SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFVLPDDDV QGIQSLYGPG DEDPNPKHPK
Macaca_mulatta                SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Macaca_nemestrina             SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Microcebus_murinus            SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFVLPDDDV QGIQSLYGPG DEDPNPKHPK
Nomascus_leucogenys           SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Nycticebus_coucang            SSKGYNLFLV AAHELGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPEDDV QGIQFLYGPG DEDPNPKHPK
Otolemur_garnettii            SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFVLPEDDV QGIQSLYGPG DEDPNPKHPK
Pan_paniscus                  SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Pan_troglodytes               SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Papio_anubis                  SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFVLPDDDV QGIQSLYGPG DEDPNPKHPK
Piliocolobus_tephrosceles     SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Pongo_abelii                  SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Pongo_pygmaeus                SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Saimiri_boliviensis           SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTSK NHFMLPDDDV QGIQFLYGPG DEDPNPKHPK
Sapajus_apella                SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTSK SHFMLPDDDV QGIQFLYGPG DEDPNPKHPK
Symphalangus_syndactylus      SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Theropithecus_gelada          SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFVLPDDDV QGIQSLYGPG DEDPNPKHPK
Trachypithecus_francoisi      SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
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281

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Homo_sapiens | TPDKCDPSLS | LDAITSLRGE | TMIFKDRFFW | RLHPQQVDAE | LFLTKSFWPE | LPNRIDAAYE | HPSHDLIFIF |
| Mus_musculus | TPEKCDPALS | LDAITSLRGE | TMIFKDRFFW | RLHPQQVEAE | LFLTKSFWPE | LPNHVDAAYE | HPSRDLMFIF |
| Aotus_nancymaae | TPDKCDPSLS | LDAITSLRGE | TMVFKDRFFW | RLHPQQVDAE | LFLTKSFWPE | LPNRIDAAYE | HPSRDLIFIF |
| Carlito_syrichta | TPDKCDPSLS | LDAITSLRGE | TMIFKDRFFW | RLHPQQVDAE | LFLTKSFWPE | LPNRIDAAYE | HPSRDLIFIF |
| Cebus_imitator | TPDKCDPSLS | LDAITSLRGE | TMVFKDRFFW | RLHPQQVDAE | LFLTKSFWPE | LPNRIDAAYE | HPSHDLIFIF |
| Gorilla_gorilla | TPDKCDPSLS | LDAITSLRGE | TMIFKDRFFW | RLHPQQVDAE | LFLTKSFWPE | LPNRIDAAYE | HPSYDLIFVF |
| Lemur_catta | TPDKCDPSLS | LDAITSLRGE | TMIFKDRFFW | RLHPQQVDAE | LFLTKSFWPE | LPNRIDAAYE | HPAHDLVFVF |
| Macaca_mulatta | TPDKCDPSLS | LDAITSLRGE | TMIFKDRFFW | RLHPQQVDAE | LFLTKSFWPE | LPNRIDAAYE | HPSHDLIFIF |
| Macaca_nemestrina | TPDKCDPSLS | LDAITSLRGE | TMIFKDRFFW | RLHPQQVDAE | LFLTKSFWPE | LPNRIDAAYE | HPSHDLIFIF |
| Microcebus_murinus | TPDKCDPSLS | LDAITSLRGE | TMIFKDRFFW | RLHPQQVDAE | LFLTKSFWPE | LPNRIDAAYE | HPSHDLVFFF |
| Nomascus_leucogenys | TPDKCDPSLS | LDAITSLRGE | TMIFKDRFFW | RLHPQQVDAE | LFLTKSFWPE | LPNRIDAAYE | HPSHDLIFIF |
| Nycticebus_coucang | TPDKCDPSLS | LDAITSLRGE | TIIFKDRFFW | RLHPQQVDAE | LFLTKSFWME | LPNRIDAAYE | HPSHDLVFIF |
| Otolemur_garnettii | TPDKCDPSLS | LDAITNLRGE | TIIFKDRFFW | RLHPQQVDAE | LFLTKSFWLE | LPNRIDAAYE | HPSHDLVFIF |
| Pan_paniscus | TPDKCDPSLS | LDAITSLRGE | TMIFKDRFFW | RLHPQQVDAE | LFLTKSFWPE | LPNRIDAAYE | HPSHDLIFIF |
| Pan_troglodytes | TPDKCDPSLS | LDAITSLRGE | TMIFKDRFFW | RLHPQQVDAE | LFLTKSFWPE | LPNRIDAAYE | HPSHDLIFIF |
| Papio_anubis | TPDKCDPSLS | LDAITSLRGE | TMIFKDRFFW | RLHPQQVDAE | LFLTKSFWPE | LPNRIDAAYE | HPSHDLIFIF |
| Piliocolobus_tephrosceles | TPDKCDPSLS | LDAITSLRGE | TMIFKDRFFW | RLHPQQVDAE | LFLTKSFWPE | LPNRIDAAYE | HPSHDLIFIF |
| Pongo_abelii | TPDKCDPSLS | LDAITSLRGE | TMIFKDRFFW | RLHPQQVDAE | LFLTKSFWPE | LPNRIDAAYE | HPSHDLIFIF |
| Pongo_pygmaeus | TPDKCDPSLS | LDAITSLRGE | TMIFKDRFFW | RLHPQQVDAE | LFLTKSFWPE | LPNRIDAAYE | HPSHDLIFIF |
| Saimiri_boliviensis | TPDKCDPSLS | LDAITSLRGE | TMVFKDRFFW | RLHPQQVDAE | LFLTKSFWPE | LPNRIDAAYE | HPSHDLIFIF |
| Sapajus_apella | TPDKCDPSLS | LDAITSLRGE | TMVFKDRFFW | RLHPQQVDAE | LFLTKSFWPE | LPNRIDAAYE | HPSHDLIFIF |
| Symphalangus_syndactylus | TPDKCDPSLS | LDAITSLRGE | TMIFKDRFFW | RLHPQQVDAE | LFLTKSFWPE | LPNRIDAAYE | HPSHDLIFIF |
| Theropithecus_gelada | TPDKCDPSLS | LDAITSLRGE | TMIFKDRFFW | RLHPQQVDAE | LFLTKSFWPE | LPNRIDAAYE | HPSHDLIFIF |
| Trachypithecus_francoisi | TPDKCDPSLS | LDAITSLRGE | TMIFKDRFFW | RLHPQQVDAE | LFLTKSFWPE | LPNRIDAAYE | HPSHDLIFIF |

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                                351
Homo_sapiens                    RGRKFWALNG YDILEGYPKK ISELGLPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Mus_musculus                    RGRKFWALNG YDILEGYPRK ISDLGFPKEV KRLSAAVHFE NTGKTLFFSE NHVWSYDDVN QTMDKDYPRL
Aotus_nancymaae                 RGRKFWALNG YDILEGYPKK ISELGFPKEI KKISAAVHFE DTGRTLFFSG NHVWRYDDTN QIMDKDYPRL
Carlito_syrichta                RGRKFWALNG YDIMEGYPQK ISELGFPKEV KKISAAVHFE DTGKTLFFSG NQVWSYDDTN HVMDKDYPRF
Cebus_imitator                  RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGRTLFFSG NQVWRYDDTN QIMDKDYPRL
Gorilla_gorilla                 RGRKFWALNG YDILEGYPKK ISELGLPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Lemur_catta                     RGRKFWALNG YDIMEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLFFSG NQVWRYDDTN HIMDTDYPRL
Macaca_mulatta                  RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Macaca_nemestrina               RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Microcebus_murinus              RGRKFWALNG YDIMEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLFFSG NQVWRYDDTN QIMDKDYPRL
Nomascus_leucogenys             RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Nycticebus_coucang              RGRKFWALNG YDIMEGYPKK ISELGFPKEV KKISAAVHFE DRGKTLFFSG NQVWSYDDTN HIMDKDYPRL
Otolemur_garnettii              RGRKFWALNG YDIMEGYPKK ISELGFPKEV KKISAAVHFE DRGKTLFFSG NQVWSYDDTN HIMDKDYPRL
Pan_paniscus                    RGRKFWALNG YDILEGYPKK ISELGLPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Pan_troglodytes                 RGRKFWALNG YDILEGYPKK ISELGLPKEV KKISATVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Papio_anubis                    RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Piliocolobus_tephrosceles       RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Pongo_abelii                    RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Pongo_pygmaeus                  RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Saimiri_boliviensis             RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLFFSG NQVWRYDDTN QIMDKDYPRL
Sapajus_apella                  RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGRTLFFSG NQVWRYDDTN QIMDKDYPRL
Symphalangus_syndactylus        RGRKFWALNG YDILEGYPQK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Theropithecus_gelada            RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Trachypithecus_francoisi        RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
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                            421
Homo_sapiens                IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Mus_musculus                IEEEFPGIGN KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPTNSIL
Aotus_nancymaae             IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSKRI VRVMPANSIL
Carlito_syrichta            IEEVFPGIGD KVDAVYEKNG YIYFFNGPIQ FEF------- ---------- ---SVWSKRI VRVMTANSLL
Cebus_imitator              IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSKRI VRVMPANSIL
Gorilla_gorilla             IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Lemur_catta                 IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPTNSLL
Macaca_mulatta              IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Macaca_nemestrina           IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Microcebus_murinus          IEEDFPGIGD KVDAVYEKNG YIYFFSGPIQ FEY------- ---------- ---SIWSNRI VRVMPTNSLL
Nomascus_leucogenys         IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
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Papio_anubis                IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
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Pongo_abelii                IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Pongo_pygmaeus              IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Saimiri_boliviensis         IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSKRI VRVMPANSIL
Sapajus_apella              IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSKRI VRVMPANSIL
Symphalangus_syndactylus    IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Theropithecus_gelada        IEEDFPGIGD KVDAVYEKNE SHFVVQAGVQ WHNLSSLQPP PPGFKRFSCL SLRSSWNYRL YLFFQRAHTV
Trachypithecus_francoisi    IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
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                            491
Homo_sapiens                WC
Mus_musculus                WC
Aotus_nancymaae             WC
Carlito_syrichta            WC
Cebus_imitator              WC
Gorilla_gorilla             WC
Lemur_catta                 WC
Macaca_mulatta              WC
Macaca_nemestrina           LC
Microcebus_murinus          WC
Nomascus_leucogenys         WC
Nycticebus_coucang          WC
Otolemur_garnettii          WC
Pan_paniscus                WC
Pan_troglodytes             WC
Papio_anubis                WC
Piliocolobus_tephrosceles   WC
Pongo_abelii                WC
Pongo_pygmaeus              WC
Saimiri_boliviensis         WC
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Symphalangus_syndactylus    WC
Theropithecus_gelada        --
Trachypithecus_francoisi    WC
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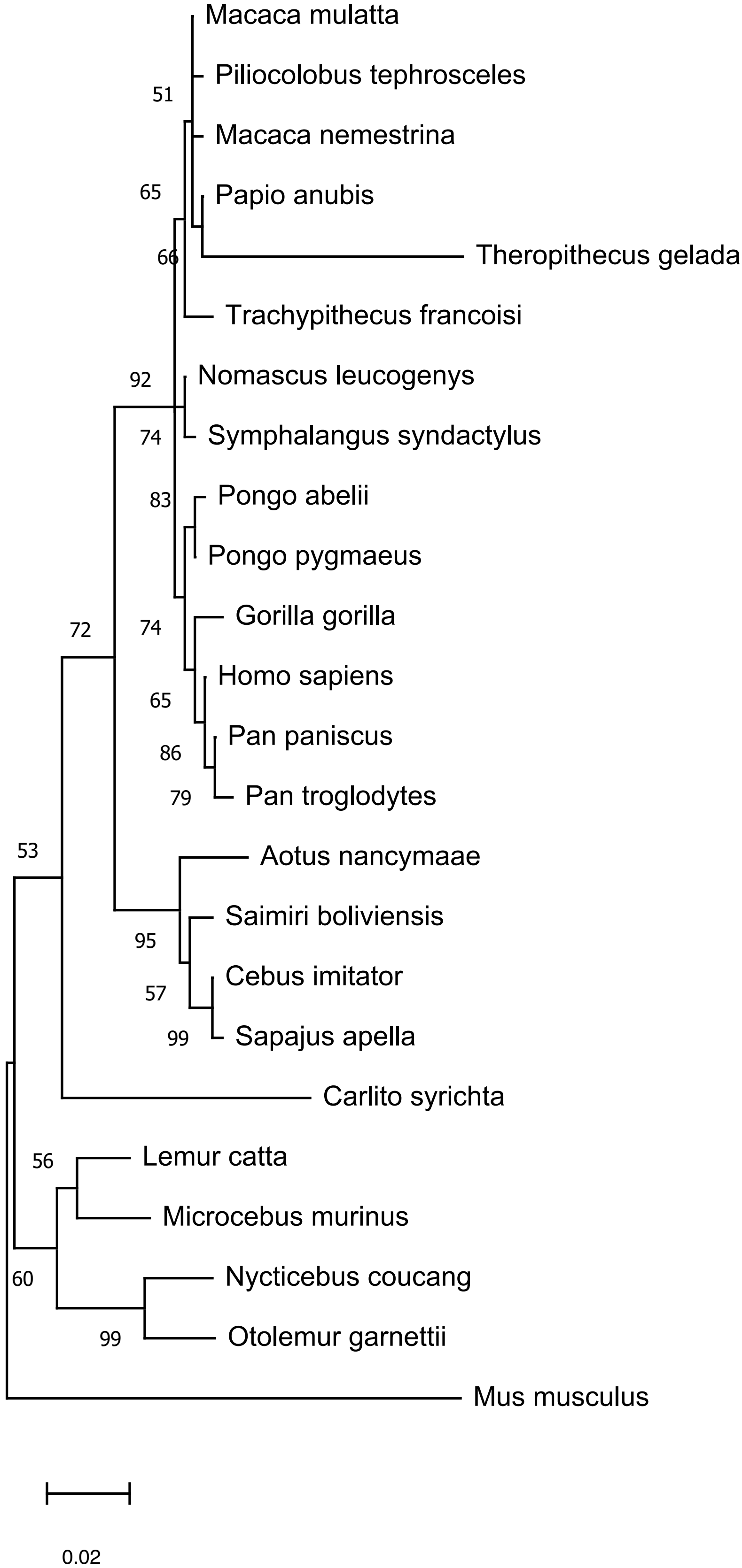
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Macaca nemestrina
Papio anubis
Theropithecus gelada
Trachypithecus francoisi
Nomascus leucogenys
Symphalangus syndactylus
Pongo abelii
Pongo pygmaeus
Gorilla gorilla
Homo sapiens
Pan paniscus
Pan troglodytes
Aotus nancymaae
Saimiri boliviensis
Cebus imitator
Sapajus apella
Carlito syrichta
Lemur catta
Microcebus murinus
Nycticebus coucang
Otolemur garnettii
Mus musculus
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A glimpse on the discussions…

# A Bioinformatic Study on the Molecular Evolution of Collagenases in Primates

*A project report submitted to the **University of Calicut** in partial fulfilment of the requirement for the award of the Degree*

## BACHELOR OF SCIENCE IN ZOOLOGY

BY


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**MARCH 2024**

# CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA
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## CERTIFICATE

This is to certify that the project work entitled **'A Bioinformatic Study on the Molecular Evolution of Collagenases in Primates'** is an authentic record of research work carried out by **Chandana Janardhanan, Lakshmi AP, Niharika, Salvador VS, Abhinav Krishna PV, Aysha Nedha Sakir, Mithralmajan PT, Anjima NC** and **Grace Maria Paulson** as part of BSc syllabus during the year **2023-2024** and the results of this work has not been presented for the award of any other degree/ diploma in any university.

### Certified bona fide by

**Dr. Leyon Varghese**
Supervising Guide

**Dr Sudhikumar A. V.**
Head, Department of Zoology

Date :

Place :

### Examined by

1. ______________________________

2. ______________________________

# DECLARATION

We, the following students do hereby declare that this project report entitled **'A Bioinformatic Study on the Molecular Evolution of Collagenases in Primates'** is a genuine record of the project work done by us under the guidance of Dr. Leyon Varghese, Assistant Professor, Department of Zoology, Christ College (Autonomous), Irinjalakuda and that this report has not been submitted to any University/Institution for the award of any Degree or Diploma. We further declare that the results presented in this work and considerations made therein, contribute in general to the advancement of knowledge in science and is devoid of any plagiarism.

| Sl. No. | Name of Students | Register No. | Signature |
|---|---|---|---|
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| 3 | Niharika | CCAVSZO010 | |
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| 9 | Grace Maria Paulson | CCAVSZO036 | |

Place : Irinjalakuda

Date : 28-02-2024

# CONTENTS

## INTRODUCTION

The first true primates evolved around 55 million years ago or a bit earlier, near the beginning of the Eocene Epoch. Their fossils have been found in North America, Europe, and Asia. They looked different from the present day primates. Changes in gene regulation and differences in mRNA expression levels across primates have often been documented, however, it is not yet known to what extent measurements of divergence in mRNA levels reflect divergence in protein expression levels, which are probably more important in determining phenotypic differences. Collagenases, a subgroup of Matrix matalloproteases (MMPs) are a large family of zinc-dependent endopeptidases with a great affinity for several components of the extracellular matrix. The collagenases include MMP-1 (interstitial collagenase/collagenase-1), MMP-8 (neutrophil collagenase/collagenase-2), and MMP-13 (collagenase-3). These MMPs attack triple helical regions of interstitial collagen types I, II, and III at a specific single site after the Gly residue of the partial sequences Gly-(Ile or Leu)-(Ala or Leu), located about three-fourths of the distance from the N-terminus. This cleavage generates fragments approximately three-fourths and one-fourth of the size of the collagen molecules. They are distinct from a closely related gelatinases (MMP2 and 9) that are characterized by the presence of the additional fibronectin domain located inside the catalytic domain.

A phylogenetic tree or evolutionary tree is a graphical representation which shows the evolutionary history between a set of species or taxa during a specific time. In other words, it is a branching diagram or a tree showing the evolutionary relationships among various biological species or other entities based upon similarities and differences in their physical or genetic characteristics. In evolutionary biology, all life on Earth is theoretically part of a single phylogenetic tree, indicating common ancestry. Phylogenetics is indeed the study of this phylogenetic tree. The main challenge is to find a phylogenetic tree representing optimal evolutionary ancestry between a set of species or taxa. The first step in the phylogenetic tree construction (using bioinformatics tool) with a new sequence would be to use BLAST. This nifty yet powerful resource matches your sequence to the millions of sequences stored in genomic and nucleotide databases. The tool comes up with the sequences most similar to the query submitted.

It also gives insights as to the possible identity of those sequences. The results include homologues across species and in similar tissues or organisms. A sequence alignment is a way of arranging the sequences of DNA, RNA, or protein to identify regions of similarity that may be a consequence of functional, structural, or evolutionary relationships between the sequences. If two sequences in an alignment, they share a common ancestor and mismatches can be interpreted as point mutations and gaps as indels (that is, insertion or deletion mutations) introduced in one or both lineages in the time since they diverged from one another. In sequence alignments of proteins, the degree of similarity between amino acids occupying a particular position in the sequence can be interpreted as a rough measure of how conserved a particular region or sequence motif is among lineages.

Phylogenetics and sequence alignment are closely related fields due to the shared necessity of evaluating sequence relatedness. The field of phylogenetics makes extensive use of sequence alignments in the construction and interpretation of phylogenetic trees, which are used to classify the evolutionary relationships between homologous genes represented in the genomes of divergent species. The degree to which sequences in a query set differ is qualitatively related to the sequences evolutionary distance from one another. Roughly, high sequence identity suggests that the sequences in question have a comparatively young most recent common ancestor, while low identity suggests that the divergence is more ancient. This approximation, which reflects the “molecular clock” hypothesis that a roughly constant rate of evolutionary change can be used to extrapolate the elapsed time since two genes first diverged , assumes that the effects of mutation and selection are constant across sequence lineages.

**REVIEW OF LITERATURE**

Primates are unique among placental mammals. Two extreme type of placentation are present in this single order. Strepsirrhines have non-invasive epitheliochorial placentation and Haplorhines have highly invasive haemochorial placentation. Strepsirrhines include Lemurs and Lorisiforms and Haplorhines include tarsiers and higher primates. Resemblance in placenta type provide the first evidence that tarsiers are linked to higher primates and distinct from lemurs and lorisiforms. Tree-shrews have endotheliochorial placentation and differ from both primate subgroups. Endotheliochorial placentation is primitive and epitheliochorial placentation is unlikely to be primitive.The recent availability of comprehensive molecular phylogenies for placental mammals has provided an independent framework to determine the most parsimonious interpretation of the evolution of placenta types (Robert Martin, 2008). In an earlier elaborate study, speciation between primates and rodents was estimated by looking at the protein coding genes of mitochondrial genomes from 31 mammals (A.D Yoder 2000). Based on paleontological data, three calibration points were used: one at 20–25 MYA for the hominoid/cercopithecoid divergence, one at 53–57 MYA for the cetacean/artiodactyl divergence, and the third at 110–130 MYA for the metatherian/eutherian divergence. Nulceotide and the amino acid sequence were looked at and results produced that were not mutually exclusive.

Even with decades of data and methods, we still can’t agree on the exact evolutionary tree of higher primates (apes and humans). The most likely scenario has humans closest to chimps, but other possibilities exist. Despite numerous theories, 20 key reasons cause this uncertainty. New methods using DNA offer hope for more definitive answers. (Holmquist et al 1988). Primate phylogeny forms a solid framework for a novel depiction of diverse patterns of genome evolution among primate lineages. They are essential for future comparative genomic investigation of adaptation and selection in humans and across primates. Studies on the evolution of catarrhine primates were done using molecular, fossil and bio geographical data. It was found that the common ancestor of Old World Monkeys originated in Africa and some monkeys later moved to Asia around 10 million years ago. The study further suggested that the ancestor of the

living hominids left Africa about 20 mya and the common ancestor of the living African apes returned to Africa from Eurasia around 10 mya (Caro-Beth Stewart, Todd R Disotell 1998).

In the deep study of evolutionary roots of strepsirrhine primate labyrinthine morphology, geometric morphometric analysis showed that the labyrinthine morphology of extant strepsirrhines contains a mixed locomotor, allometric and phylogenetic signal. Discriminant analysis at the family level confirmed that labyrinthine shape is a good taxonomic marker. The results support the hypothesis that evolutionary change in labyrinthine morphology is adequately described with a random walk model, i.e. random phenotypic dispersal in morphospace (Lebrun et al, 2010). An overview of the taxonomy of New World primates based on morphology to the great number of studies based on molecular data aiming for the elucidation of the phylogeny of New World monkeys. The traditional classification of the infraorder Platyrrhini divided these primates into Cebidae and the Callitrichidae, with Callimico being allocated to either the former (Simons, 1972, Simpson, 1945) or the latter family. Hill (1957) and Hershkovitz, 1972, Hershkovitz, 1977 proposed a third family – Callimiconidae – to accommodate Callimico, because it shares characteristics that define both cebids and callitrichids. According to Hershkovitz (1977), then all New World primates should be included in one of three families – the Callitrichidae which comprised the marmosets, tamarins (Saguinus) and lion tamarins (Leontopithecus), the monotypic Callimiconidae (Callimico) and the Cebidae (Schneider et al, 2015).

In a study on molecular phylogeny and evolution of primate mitochondrial DNA, researchers determined nucleotide sequences of homologous 0.9-kb fragments of mitochondrial DNAs (mtDNAs) derived from four species of old-world monkeys, one species of new-world monkeys, and two species of prosimians. With these nucleotide sequences and homologous sequences for five species of hominoids, they constructed a phylogenetic tree for the four groups of primates. The phylogeny obtained is generally consistent with evolutionary trees constructed in previous studies. The results also suggest that the rate of nucleotide substitution for mtDNAs in hominines (human, chimpanzee, and gorilla) have slowed down compared with that for old-world monkeys (Hayasaka, 1988). Mitochondrial genomes have been used to study the

phylogenetic relationship of primates in detail. Using 454 sequencing, the study adds 32 new complete mitochondrial genomes and introduces 20 previously unrepresented genera in the primate tree. The study focuses on the New world monkeys and suborder Strepsirrhini. (Knut Finstermeier, et al 2013). The evolutionary relationships of the number of species within the genus Lepilemur were analysed with the help of a comparative cytogenetic and molecular study. The study involved the complete sequencing of the mitochondrial cytochrome b gene from 68 individuals and the results were compared to those obtained from cytogenetic studies derived from 99 specimens. The results support the classification of the eight major supportive lemur taxa as independent species. (Nicole Andriaholinirina, et al. 2006)

The relationship between the prion protiens and new world primate phylogeny have been studied. The PrP C prion protein contains 250 amino acids with some variation among species and is expressed in several cell types. Variations in the prion protein gene were observed among 16 genera of New World primates (Platyrrhini), and resulted in amino acid substitutions when compared with the human sequence. Schneider et al, 2004)

Beta-globin gene cluster of primates were analyzed to understand their evolutionary history. The rate of accumulation of mutations have also been seen to vary by a factor of 7 among different primate lineages. The study groups superfamilies Lemuroidea and Lorisoidea into suborder Strepsirhini and Tarsius and Anthropoidea into suborder Haplorhini. Evolution rates have been suggested to have slowed down over the past 25 million years of hominoid descent and has found to have happened in correlation with lengthened lifespans (Koop, BF et al 1989).

Using the SINE's methods for the analysis of mobile element based of old world monkeys. It helps to known ancestral staples. Makes them to useful genetic studies for phylogenetic studies. Alu is an helping part of it, in this methods found 285 new Alu Insertions from sixteen old world monkeys. Old world monkeys are represent on the most diverse and largest primate families. And have respect classification. The phylogenetic researchers are classified and grouped the old world monkeys into different classes and divisions. Mainly the subfamily cerocopithecidae are the most studied group.. SINEs ( short interspersed element are

used  as the genetic markers this  will helps to analysis several levels of phylogenetic analysis. Using both Compcompuational and PCR methods (Xing a et al, 2005).

New world monkeys represent monophyletic group. The phylogenetic relationships among new world monkeys have been extensively investigated using nucleotide sequence from different genome.In these studies still there are some unresolved issues.There are three monophyletic new world monkey families Atelidae, Cebidae and Pitheciidae. As a result Maximum parsimony analysis support the three proposed platyrrhine families. In the maximum parsimony tree, the two most closely related families are Atelidae and Cebidae.Phylogenetic relationships were reconstructed by maximum parsimony, maximum likelihood, and Bayesian approaches (JuanC Opazo et al, 2006). Anthropoid primates from the neotropics are members of parvorder Platyrrhini. The platyrrhines are also called New World monkeys. There are more than 125 species of extant New World monkeys  found in approximately 15 genera. The phylogenetic relationships of these neotropical primates have been extensively studied from a molecular perspective (Derek wildman et al, 2009).

Phylogenetic trees are certainly useful for comparative studies, providing a useful framework for comparative biologists. Species evolution is not statistically independent. The fact that close relatives inherit characteristics from their common ancestor has always complicated the analysis of cross- species data. The methods in turn developed to resolve such issues, all requires resolved phylogeny. In one of the earlier studies, primates phylogeny was estimated of all 203 species of primates. Application of parsimony algorithm and bootstrapping resulted in the composite tree with 160 nodes (Purvis, Andy 1995).

In a project conducted under the support from National Cancer Institute and National Institute of Health, researchers constructed a robust phylogenetic tree of primates. The tree was constructed from the data collected of genomic sequences from 186 primates. Also outgroup species from Dermoptera, Scandentia and Lagomorpha was included. This phylogenetic representation done carefully was a notable illumination showing the pathway of primates evolution (Perelman et.al 2011).

Studies also estimated the molecular divergence dates of major primates in the context of molecular clock studies. Such studies also aid in understanding the lineage. Utilizing the genomic data, molecular divergence dates were able to be studied since alignments can be arranged and sites can be analysed for this study. Much before the molecular clock, paleontology used to provide only a mere timeframe of species evolution (Steiper et.al. 2006).

Inferring molecular phylogeny for evolutionary studies are done in non- primates as well. The molecular phylogeny of malarial parasites was recovered from mitochondrial cytochrome b gene sequences. Parsimony as well as maximum- likelihood analysis produced similar phylogenetic trees in this case. The conclusions were supported by hypothesis testing (Perkins et.al 2002). Inferring species super matrix has helped in studying macroevolutionary dynamics and even historical biogeography. The results obtained highlighted both the power as well as limitations of inferring the molecular phylogeny data to different species concepts (Springer et.al. 2012).

Over the past 60 million years, a million copies of Alu DNA have appeared in the genomes of primates. This is still an ongoing process. DNA alu repeats in the genomes of primates such as human, chimpanzee, gorilla, orangutan, baboon, rhesus, and macaque. New Alu elements arise in unique and irreversible events and appear to prevent precise excision and loss. The same insertions cannot occur independently in two species. Once the insert is genetically fixed, the DNA elements persist in all descendant lineages. Different from point mutation, the distribution of individual alu corresponds to a phylogeny only (H. Hamdi, 1999).

To resolve the debate in strepsirrhine phylogeny, 61 loci containing interspersed elements were characterized and the absence and presence of orthologous loci in the strepsirrhine panel was determined. According to these findings, it is concluded that strepsirrhines originated in Africa, and that Madagascar and Asia were colonized by immigration events (C. Roos, 2004). To investigate the phylogenetic relationships among species of New World monkeys, 1.3 kb of DNA was collected for 2 introns of the glucose-6-phosphate dehydrogenase locus encoded on the x chromosome of 24 species of New World monkeys (M. Von. Dornum, 1999).

Two molecular based approaches are used to date the initial divergence of the platyrrhine clade, a relaxed clock model using fossil record and genome datasets, and Bayesian inferences from generation time and body size to substitution rate. Fossil constraints, topology, and substitution rate are an important part of our divergence time estimates. making an impact. Bayesian estimates using conservative and realistic fossil constraints suggest that the LCA of extant platyrrhines is 29 Ma, with a 95% confidence interval for Nodine of 27–31 Ma (SI Perez, 2013). The sequences of nuclear protein-coding gene LCAT were used to study the relationship between 19 extant rodents. The study agrees with several previous molecular and morphological studies, both concerning branching orders inside Muroidea and the bush-like radiation of rodent suprafamilial taxa. This indicates that this nuclear gene is a fitting candidate for tackling questions about rodents relationships.

The data from primates were used to reveal that the molecular clock in CpG and non-CpG sites have different nature, projecting differences in their molecular origin. Through the process, it was observed that molecular clocks are heterogeneous even within a genome. During phylogenetic analysis and while concluding divergence times using molecular data, one should be mindful that different regions of genome follow different molecular clocks. In this study, our efforts are directed towards studying the pathway of certain collagenases in the course of evolution. Even though some studies have been done using DNA sequences and that too in different context, in our study we focusses primarily on amino acid sequences. This is not a well researched area. Though this study we aim on providing a new work in the area of comparative biology. The results of the work may be useful in the future providing insights into how may be the few crucial changes in amino acids may have resulted into a complete new lineage.

## SIGNIFICANCE OF THE STUDY

The study of molecular evolution in primates through the comparison of amino acid sequences using bioinformatics tools represents a novel and underexplored area of research. To date, there has been a notable scarcity of studies employing bioinformatics techniques to investigate the evolutionary patterns of primates, particularly in relation to proteins such as MMP1, MMP8 and MMP13 collagenases. The selection of these collagenases for our study is particularly significant due to their split genes nature. By conducting a comparative analysis of the evolutionary trees derived from the collagenases with established standard trees, we aimed to shed light on the distinctive evolutionary trajectories of these proteins in primates. The insights obtained from this comparative study have the potential to deepen our understanding of the molecular evolution of primates and elucidate the factors driving the evolution of collagenases in this taxonomic group.

**OBJECTIVES**

1. Retrieval of relevant data (Gene/mRNA/protein sequence of collagenases of primates) from relevant reliable resources such as NIH or SIB.
2. Align the retrieved sequences using bioinformatics software to ensure they are in the correct reading frame and homologous positions are appropriately aligned.
3. Construction of the phylogenetic trees based on the Gene/mRNA/protein sequence of collagenases in primates.

## METHODOLOGY

The three human collagenases used in the study are MMP1, MMP8 and MMP13. The FASTA sequence and other details of collagenases are as below.

```
>NP_002412.1 interstitial collagenase isoform 1 MMP1 UniProt_P03956 [Homo sapiens]
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FGLKVTGKPDAETLKVMKQPRCGVPDVAQFVLTEGNPRWEQTHLTYRIENYTPDLPRADVDHAIEKAFQL
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>NP_002418.1 collagenase 3 MMP13 UniProt_P45452 [Homo sapiens]
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The study on phylogenetic relationships in primates was conducted using this amino acid sequences to do the BLAST (Basic Local Alignment Search Tool) analysis in the NCBI Genebank database. The most suitable amino acid sequences for each primate species were then carefully selected from sequences delivered by the server. An out group was chosen which in our study was the Mus musculus of the order Rodentia.

The selected sequences were then compared with that of the out group and a phylogenetic tree was constructed based on the degree of divergence. The software used for constructing phylogenetic tree was  Molecular Evolutionary Genetics Analysis (MEGA).

## RESULTS AND DISCUSSIONS

The research article titled "A Molecular Phylogeny of Living Primates" published in 2011, established a robust and widely accepted framework for understanding primate evolution. This phylogenetic tree served as a standard reference for our study, allowing us to compare our data and draw conclusions. According to this article Order Primata is subdivided into two major Suborder Haplorrhini and Strepsirrhini. The remaining primate phylogeny is classified as follows.

**Suborder Haplorrhini** further divides into Infraorders, namely Simiiformes and Tarsiiformes. Tarsiiforme include only one Family (Tarsiidae) with only two extant species. Simiiformes is subdivided into Parvorders Catarrhini (Old world) and Platyrrhini (New world).

Parvorder Catarrhini in turn consist of the Superfamilies Cercopithecoidea and Hominoidea. Cercopithecoidea has only one extant Family *viz*. Cercopithecidae but the organisms of Superfamily Hominoidea is further divided into two Families, *viz*, Hylobatidae and Hominidae. Family Cercopithecidae has two Subfamilies such as Cercopithecinae and Colobinae. Family Hylobatidae include all Gibbon Genus and there is no further subgrouping. Hominidae on the other hand has two Subfamilies *viz.* Homininae and Ponginae. Subfamily Ponginae include all species of Orangutang and all o there Greater Apes and Humans are included in Homininae. Subfamily Cercopithecinae is subdivided into two Tribes namely, Papionini and Cercopithecini whereas Colobinae is subdivided into two Tribes namely Presbytini and Colobini.

Parvorders Platyrrhini on the other hand is divided directly into three Families such as Cebidae, Atelidae and Pitheciidae. Family Cebidae has four Subfamilies namely, Callitrichinae, Aotinae, Cebinae and Saimirinae. Fly. Atelidae has two Subfamilies (Atelinae & Alouattinae) so also Fly. Pitheciidae (Callicebinae & Pitheciinae).

**Suborder Strepsirrhini** is divided into the Infraorders Lemuriformes, Chiromyiformes and Lorisiformes. Unlike Haplorrhini, there is no observed grouping of these Infraorders into Parvorders or Superfamilies. Instead, they are grouped into Families such as Lepilemuride,

Cheirogaleidae, Indriidae, Lemuridae, Daubentoniidae, Lorisidae and Galagidae. Further subdivision within Lorisidae includes the subfamilies Lorisinae and Perodicticinae.

**MMP-1**

The phylogenetic tree for the MMP1 gene in primates was meticulously constructed, employing an analysis of amino acid sequences from various primate species. To enhance our phylogenetic analysis, *Mus musculus* was strategically employed as the outgroup, providing a reference point for the evolutionary relationships within the MMP1 collagenase gene among primates. Our investigation also utilized a well established standard phylogenetic tree for primates, derived from genomic sequences across diverse species, serving as a foundational reference for elucidating the evolutionary dynamics of collagenase genes within our study group (Reference). The results obtained regarding the evolutionary pathway of the MMP1 gene include the following observations:

- *Carlito syrichta*: Our findings indicate that MMP1 gene of *Carlito syrichta,* a tarsier species primarily descended with minimal changes from the common ancestor of all primates indicating an ancient ancestry. Although this tree suggests such an ancient ancestry and early divergence of *Carlito syrichta* from the early primate stock, a comparison with the established tree reveals that tarsiers diverged from a common stock of strepsirrhini - more primitive primate. It is therefore inferred that the MMP1 gene remained with minimum changes in the tarsiers as compared to strepsirrhini primates.

- *Hominidae:* In our tree constructed using MMP1 the common ancestor of *Pan* and *Homo*, along with the common ancestor of *Gorilla* and *Pongo,* collectively share a common ancestor. Gibbons, including *Nomascus* and *Symphalangus,* share a common ancestor that along with the common ancestor of *Hominidae* were descended from a common stock of interbreeding ape like animal. Upon analysing the standard phylogenetic tree, a similar pattern emerges, with *Homo* and *Pan* sharing a common ancestor. This common ancestor was also ancestral to present day *Gorilla,* from which the *Pongo* ancestry might have diverged. However, the discrepancy in our results suggestive of *Gorilla* sharing a recent

common ancestor with *Pongo,* but not with *Homo* or *Pan*. This suggests a simultaneous origin for *Gorilla* and *Pongo*, contrary to the standard tree's assertion of *Gorilla*'s more recent evolution compared to *Pongo*. Further analysis of the amino acid sequences are required to see if the *Homo-Pan* group has any common advantage with the kind of changes on the MMP1 protein over the *Gorilla-Pongo* group.

- Old World Monkeys: Our results indicate that, three groups *viz. Macaca*, *Papio* and *Theropithecus* are equally distant from a common ancestor, while *Colobus* and *Trachypithecus* share another common ancestor. The standard phylogenetic tree confirms this, revealing a common ancestor for *Colobus* and *Trachypithecus,* along with the ancestor of *Macaca, Papio* and *Theropithecus.* But with *Macaca, Papio* and *Theropithecus,* our results differ from the standard tree. While standard tree implies that *Papio* and *Theropithecus* had a common ancestor after the common ancestry shared with *Macaca,* our tree do not mention between an ancestor common to both *Papio* and *Theropithecus.* Though the changes are minimal, it wold be interesting to look for the their sequences for further analysis.

- New World Monkeys: Our findings in New World Monkeys suggest that *Saimiri* and *Cebus* share a most recent common ancestor, while *Aotus* share a common ancestor with this lineage. This is consistent with both our phylogenetic tree and the standards phylogenetic tree. Furthermore, *Nycticebus* and *Otolemur* share a common ancestor, and *Lemur* and *Microcebus* also share a common ancestor. The common ancestors of these pairs collectively had a single common ancestor, aligning with observations on the standard phylogenetic tree.

**MMP-8**

- *Hominidae*: In the phylogenetic tree derived from MMP8 sequence data, it was observed that the common ancestor of Homo and Gorilla shares ancestry with the common ancestor of Pan. This collective ancestry is further linked to the common ancestor of Hominidae, which is shared with Gibbons. In contrast to the standard phylogenetic tree, where Pan and Homo share an ancestor ancestral to present-day Gorilla, our results suggest the potential existence of an alternative evolutionary pathway for these three species. A comprehensive investigation is recommended to explore the implications of this alternative pathway further.

- Loris: Our findings indicate that the Loris shares a common ancestor with Hominidae, Tarsier, Gibbons, New World, and Old World monkeys, all of which originate from the Strepsirrhini primates. Similarly, Lemurs are shown to arise from Haplorrhini primates. Discrepancies with the standard phylogenetic tree, which suggests a more recent common ancestry for Lemurs and Loris, necessitate further analysis to validate the proposed ancestral pattern among the descendants of these two major groups of early primates.

- New World Monkeys: Upon examining the lineage of New World monkeys, it is observed that recent descendants Aotus and Saimiri share a common ancestor, which is further linked to the common ancestor of Cebus and Sapajus. This lineage can be traced back to early Strepsirrhini primates. Although minor differences are noted compared to the standard phylogenetic tree, where an ancestor common to Saimiri and Cebus precedes the common ancestry with Aotus, further analysis is warranted to explore these nuances.

- Old World Monkeys: Our analysis reveals that Papio and Theropithecus share a common ancestor, which is connected to the common ancestor of Macaca. This ancestral lineage can be traced back to an ancestor shared with the common ancestor of Piliocolobus and Trachypithecus. The observed pattern aligns with the standard phylogenetic tree in the lineage of Old World monkeys.

**MMP-13**

- *Hominidae*: When we comparing the phylogenetic tree made by us on the basis of MMP13 and the standard one, the Nomascus leucogenys & Symphalongus syndactylus (Hylobatidae) share a recent common ancestor and they together share common ancestor with old world monkeys in MMP13. But, when we comparing this with the standard one we can observe that the Hylobatidae sharing common ancestor with Hominidae.

- New World Monkeys: Our findings in new world monkeys by comparing the Standard phylogenetic tree with the phylogenetic tree of MMP13 depicting that, in the phylogenetic tree of MMP13, the Cebus imitator & Sapajus apella shares a recent common ancestor and these group share a common ancestor with Samiri bolivensis and all of these collectively share a common ancestor with Aotus nancymaae. When we comparing this with the standard phylogenetic tree Cebus imitator & Samiri bolivensis directly arrived from a common ancestor.

- Old World Monkeys: By analysing the group Cercopithecidae in the tree of MMP13, Papio Anubis & Theropithecis gelada share a recent common ancestor and they together share a common ancestor with Macaca group, Piliocolobus tephrosceles & Trachypithecus francoisi directly. But when we comparing this with the standard phylogenetic tree, they where not sharing a common ancestor directly, all of them share a common ancestor with other species recently, but all of them primitively share a common ancestor.

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Seaview [blocks=10 fontsize=12 A4-landscape] on Wed Jan 31 07:26:41 2024

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Mus_musculus                 MPSLP---LL LLLWAASSYS FPVFHNGDRQ NVETVWKYLE NYYNL---GK NMQAKNVNGK EMMAEKLRQM
Aotus_nancymaae              MHSYPP-LLL LLFWGVVSHG FPATLETQEQ DVEIVQKYLE QYYNLKNDGK QVEKKRSSGP --VVEKLKQM
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Microcebus_murinus           MPRFS--LLL LLLWSLGSHG LPVAPETQEQ DVEIVQKYLE NYYDLKNDGK QIEKKRNSGP --VVEKLKQM
Nomascus_leucogenys          MHSFPPLLLL LLFWSVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGL --VVEKLKQM
Nycticebus_coucang           MPSF---LLL LLLWGLGSHA FPAIPEPQEQ DVEIVQKYLE NYYDLKNDGS QIERKRNSGP --VVEKLKQM
Otolemur_garnettii           MSSFP--LLL LLLWGLGSHA LPVTPETQEQ DVEIVQKYLE NYYDLKNDGM QIERKRNSGP --VVEKLKQM
Pan_paniscus                 MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Pan_troglodytes              MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Papio_anubis                 MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Piliocolobus_tephrosceles    MHSFPPLLLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVQKQRNSGP --VVEKLKQM
Pongo_abelii                 MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Pongo_pygmaeus               MHSFPP-LLL LLFWGVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKRRNSGP --VVEKLKQM
Saimiri_boliviensis          MHSYPP-LLL LLFWSVVSHG FPATLETQEQ DVEIVQKYLE QYYDLKNDGK QVEKQRNSGP --VVEKLKQM
Sapajus_apella               MHSYPL-LLL LLFWGVVSHG FPATLETQEQ DVEIVQKYLE QYYNLKNDGK QVEKQRNSGP --VVEKLKQM
Symphalangus_syndactylus     MHSFPPLLLL LLFWSVVSHS FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGL --VVEKLKQM
Theropithecus_gelada         MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDGR QVEKQRNSGP --VVEKLKQM
Trachypithecus_francoisi     MHSFPP-LLL LLFWGVVSHG FPATLETQEQ DVDLVQKYLE KYYNLKNDRR QVEKQRNSGP --VVEKLKQM
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Homo_sapiens                QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Mus_musculus                QQLFGLKVTG NSDPETLRAM KKPRCGVPDV APYAITHNNP RWTKTHLTYS ILNYTPYLPK AVVEDAIARA
Aotus_nancymaae             QEFFGLKVTG KPDAETLNVM KQPRCGVPDV ARFVLTEGNP RWEKTHLTYR IENYTPDLPR ADVDQAIEKA
Carlito_syrichta            QKFFGLKVTG KPDPETLKVM KQPRCGVPDV AQFVLTEGNP RWQKTDLTYR IENYTPDLPK AEVDRAIEKA
Cebus_imitator              QEFFGLKVTG KPDAETLKVM KQPRCGVPDV ARFVLTEGNP RWKKTHLTYR IENYTPDLPR SDVDHAIEKA
Gorilla_gorilla             QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
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Macaca_mulatta              QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR AAVDQAIEKA
Macaca_nemestrina           QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR AAVDQAIEKG
Microcebus_murinus          QEFFGLKVTG KPDTETLKVM KQPRCGVPDV ARFVLTQGNP RWEKTHLTYR IENYTPDLSR ADVDHAIEKA
Nomascus_leucogenys         QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTAGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Nycticebus_coucang          QEFFGLKVTG TPDTETLKVM KQPRCGVPDV ARFALTPGNP RWEQTHLTYR IENYTPDLPR ADVDDAIEKA
Otolemur_garnettii          QEFFGLKVTG TPDTETLKVM KQPRCGVPDV ARFVLTQGNP RWEQTHLTYR IENYTPDLPK ADVDDAIEKA
Pan_paniscus                QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIAKA
Pan_troglodytes             QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIAKA
Papio_anubis                QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR AAVDQAIEKA
Piliocolobus_tephrosceles   QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDRAIEKA
Pongo_abelii                QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Pongo_pygmaeus              QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Saimiri_boliviensis         QEFFGLKVTG KPDAETLNVM KQARCGVPDV ARFVLTEGNP RWEKTHLTYR IENYTPDLRR ADVDHAIEKA
Sapajus_apella              QEFFGLKVTG KPDAETLKVM KQPRCGVPDV ARFVLTEGNP RWEKTHLTYR IENYTPDLPR SDVDHAIEKA
Symphalangus_syndactylus    QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTAGNP RWEQTHLTYR IENYTPDLPR ADVDHAIEKA
Theropithecus_gelada        QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR AAVDQAIEKA
Trachypithecus_francoisi    QEFFGLKVTG KPDAETLKVM KQPRCGVPDV AQFVLTEGNP RWEQTHLTYR IENYTPDLPR ADVDRAIEKA
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Carlito_syrichta             FQLWSNASPL RFTKVVEGQA DIMISFVRGD HQDNSPFYGP GENLAHAFQP GPNIGGDAHF DEDETWTNNI
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Pongo_pygmaeus               FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
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Sapajus_apella               FQLWSNVTPL TFTKVPKGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDETWTNNF
Symphalangus_syndactylus     FKLWSDVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DDDERWTNNF
Theropithecus_gelada         FQLWSNVTPL TFTKVSEGQA DIMISFVRGD HRDNSPFDGP GGNLAHAFQP GPGIGGDAHF DEDERWTNNF
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Mus_musculus                ENFNLFYVTA HELGHSLGLT HSSDIGALMF PSYTWYTEDF VLNQDDINRI QDLYGPSPNP IQPTGATTPH
Aotus_nancymaae             REYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGKSQNP VQPTGPQTPQ
Carlito_syrichta            QNYNLYRVAA HEFGHSLGLS HSTDIGALMY PTYT-YSGDV QLAQDDIDGI QAIYGPSQNP IQPTGPQTPQ
Cebus_imitator              RGYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGQSPNP VQPTGPQTPQ
Gorilla_gorilla             REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Lemur_catta                 RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYT-FSGDV QLAQDDIDGI QAIYGPSQNP NQPTGPQTPQ
Macaca_mulatta              REYNLYRVAA HEFGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Macaca_nemestrina           REYNLYRVAA HELGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Microcebus_murinus          RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYA-FSGDV QLAQDDIDGI QAIYGPSQNP NQPIGPQTPQ
Nomascus_leucogenys         REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Nycticebus_coucang          RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYA-FSGEV ELAQDDIDGI QAIYGPSQNP IQPIGPQTPQ
Otolemur_garnettii          RNYNLYRVAA HELGHSLGLS HSTDIGALMY PTYA-FSGEV ELAQDDIDGI QAIYGPSQNP VQPTGPQTPQ
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Pan_troglodytes             REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Papio_anubis                REYNLYRVAA HELGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Piliocolobus_tephrosceles   REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLSQDDIDGI QAIYGGSQNP VQPTGPQTPK
Pongo_abelii                REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGPSQNP VQPIGPQTPK
Pongo_pygmaeus              REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGPSQNP VQPIGPQTPK
Saimiri_boliviensis         REYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGPSPNP VQPTGPQTPQ
Sapajus_apella              REYNLYRVAA HELGHSLGLS HSTDIGALMF PSYT-FSGDV QLAQDDIDGI QAIYGQSPNP VQPTGPQTPQ
Symphalangus_syndactylus    REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGRSQNP VQPIGPQTPK
Theropithecus_gelada        REYNLYRVAA HELGHSLGLA HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
Trachypithecus_francoisi    REYNLYRVAA HELGHSLGLS HSTDIGALMY PSYT-FSGDV QLAQDDIDGI QAIYGGSQNP VQPTGPQTPK
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                            281
Homo_sapiens                ACDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Mus_musculus                PCNGDLTFDA ITTFRGEVFF FKGRFYIRVN RFMPEPELNL IGILWPNLPV KLDAAYEASM IDQVRYFKGS
Aotus_nancymaae             VCDSKLTFDA ITTIRGEVFF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Carlito_syrichta            ACDSKISFDA VTTIRGEVMF FKDRFFMRTH PSYPEADLNF ISDFWPLLPN GLEAAYEDAG RDQVRFFKGY
Cebus_imitator              VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PYYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Gorilla_gorilla             VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLQAAYEFAD RDEVRFFKGN
Lemur_catta                 VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPS GLEAAYEVAS RDEVRFFKGN
Macaca_mulatta              VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Macaca_nemestrina           VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Microcebus_murinus          VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF VSVFWPQLPT GLEAAYEVAD RDEVRFFKGN
Nomascus_leucogenys         VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Nycticebus_coucang          VCDSKLTFDA VTTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPS GLEAAYEVVD RDEIRFFKGN
Otolemur_garnettii          VCDSKLTFDA VTTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEVAD RDEVRFFKGN
Pan_paniscus                VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PSYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Pan_troglodytes             VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Papio_anubis                VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Piliocolobus_tephrosceles   VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLQAAYEFAE RDEVRFFKGN
Pongo_abelii                VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Pongo_pygmaeus              VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Saimiri_boliviensis         VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Sapajus_apella              VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PYYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGN
Symphalangus_syndactylus    VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLEAAYEFAD RDEVRFFKGK
Theropithecus_gelada        VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYQEVELNF ISVFWPQLPK GLQAAYEFAD RDEVRFFKGN
Trachypithecus_francoisi    VCDSKLTFDA ITTIRGEVMF FKDRFYMRTN PFYPEVELNF ISVFWPQLPN GLQAAYEFAD RDEVRFFKGN
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                             351
Homo_sapiens                 KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Mus_musculus                 KVWAVQEQSV LRGFPRDIHS FFGFPSNVTH IDAAVCEEET GKTYFFVDHM YWRYDENTQS MDPGYPRLTA
Aotus_nancymaae              KYWAAQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDAGYPKMIA
Carlito_syrichta             RFWAVQGQDV LRGYPQDIYS SYGFPRTVKH IDAAVFEEET GKTFFFVGNK YWRYDEYKRS MDVGYPKMIA
Cebus_imitator               KYWAVQGQNV LYGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDAGYPKKIA
Gorilla_gorilla              KYWAVQGQNM LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDPGYPKMIA
Lemur_catta                  KYWAVQGQNV LPGYPKDIYR SFGFPRTVKH IDAAISEEDT GKTYFFVANK YWRYDEYKQS MDTGYPKKLA
Macaca_mulatta               KYWAVQGQNV LPGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Macaca_nemestrina            KYWAVQGQNV LPGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Microcebus_murinus           KYWAVQGQNV LPGYPKDIYK SFGFPKTVKH IDAAVSEEDT GKTYFFVANK YWRYDEYKQS MDAGYPKMIA
Nomascus_leucogenys          KYWAVQGQNV LHGYPKDIYS SFGFPRTVKR INAALSEENT GKTYFFVAKK YWRYDEYKRS MDPGYPKMIA
Nycticebus_coucang           KYWAVRGQDV LHGYPKDISS SFGFPRTVKH VDAAVSEEET GKTYFFVANK YWRYDENKQS MDTGYPKMIA
Otolemur_garnettii           KYWAVRGPDV LHGYPKDISS SFGFPRTVKH VDAAVSEEET GKTYFFVANK YWRYDENKQS MDTGYPKTIA
Pan_paniscus                 KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Pan_troglodytes              KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Papio_anubis                 KYWAVQGQNV LPGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIS
Piliocolobus_tephrosceles    KYWAVQGQNV LRGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Pongo_abelii                 KYWAVQGQNM LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEHKRS MDPGYPKMIA
Pongo_pygmaeus               KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYKRS MDPGYPKMIA
Saimiri_boliviensis          KYWAVQGQNV LYGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDAGYPKMIA
Sapajus_apella               KYWAVQGQNV LYGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVGNK YWRYDEYKRS MDAGYPKKIA
Symphalangus_syndactylus     KYWAVQGQNV LHGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVAKK YWRYDEYKRS MDPGYPKMIA
Theropithecus_gelada         KYWAVQGQNV LPGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK CWRYDEYKRS MDPGYPKMIA
Trachypithecus_francoisi     KYWAVQGQNV LRGYPKDIYS SFGFPRTVKH IDAALSEENT GKTYFFVANK YWRYDEYERS MDPGYPKMIA
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Homo_sapiens                    HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Mus_musculus                    EDFPGIDDKV DDVFQKGENF YFFHQSVQHR FNLQIRRVDD SRDSSTWFNC ---
Aotus_nancymaae                 DDFPGIGHKV DAVFMKDGFF YFFHKTRQYK FEPETKRILT LQKANSWFNC RKN
Carlito_syrichta                HGFPGIGHKV DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKN
Cebus_imitator                  HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Gorilla_gorilla                 HDFPGIGHKV DAVFMKDGFF YFFRGRRQYK FDPETKRILT LQKANSWFNC RKN
Lemur_catta                     LDFPGIGHKI DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKK
Macaca_mulatta                  HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Macaca_nemestrina               HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Microcebus_murinus              HDFPGIGHKI DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKN
Nomascus_leucogenys             HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Nycticebus_coucang              HDFPGIGHKV DAVFKKDEFF YFFHGTRQYK FDLKTKRILT LLKANSWFNC RKH
Otolemur_garnettii              HDFPGIGHKV DAVFKKDGFF YFFHGTRQYK FDPKTKRILT LLKANSWFNC RKH
Pan_paniscus                    HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Pan_troglodytes                 HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Papio_anubis                    HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Piliocolobus_tephrosceles       HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Pongo_abelii                    HDFPGIGHKV DAVFTKDGFF YFFHGTRQYK FDPETKRILT LQKANSWFNC RKN
Pongo_pygmaeus                  HDFPGIGHKV DAVFTKDGFF YFFHGTRQYK FDPETKRILT LQKANSWFNC RKN
Saimiri_boliviensis             HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Sapajus_apella                  HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Symphalangus_syndactylus        HDFPGIGHKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Theropithecus_gelada            HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
Trachypithecus_francoisi        HDFPGIGNKV DAVFMKDGFF YFFHGTRQYK FDPKTKRILT LQKANSWFNC RKN
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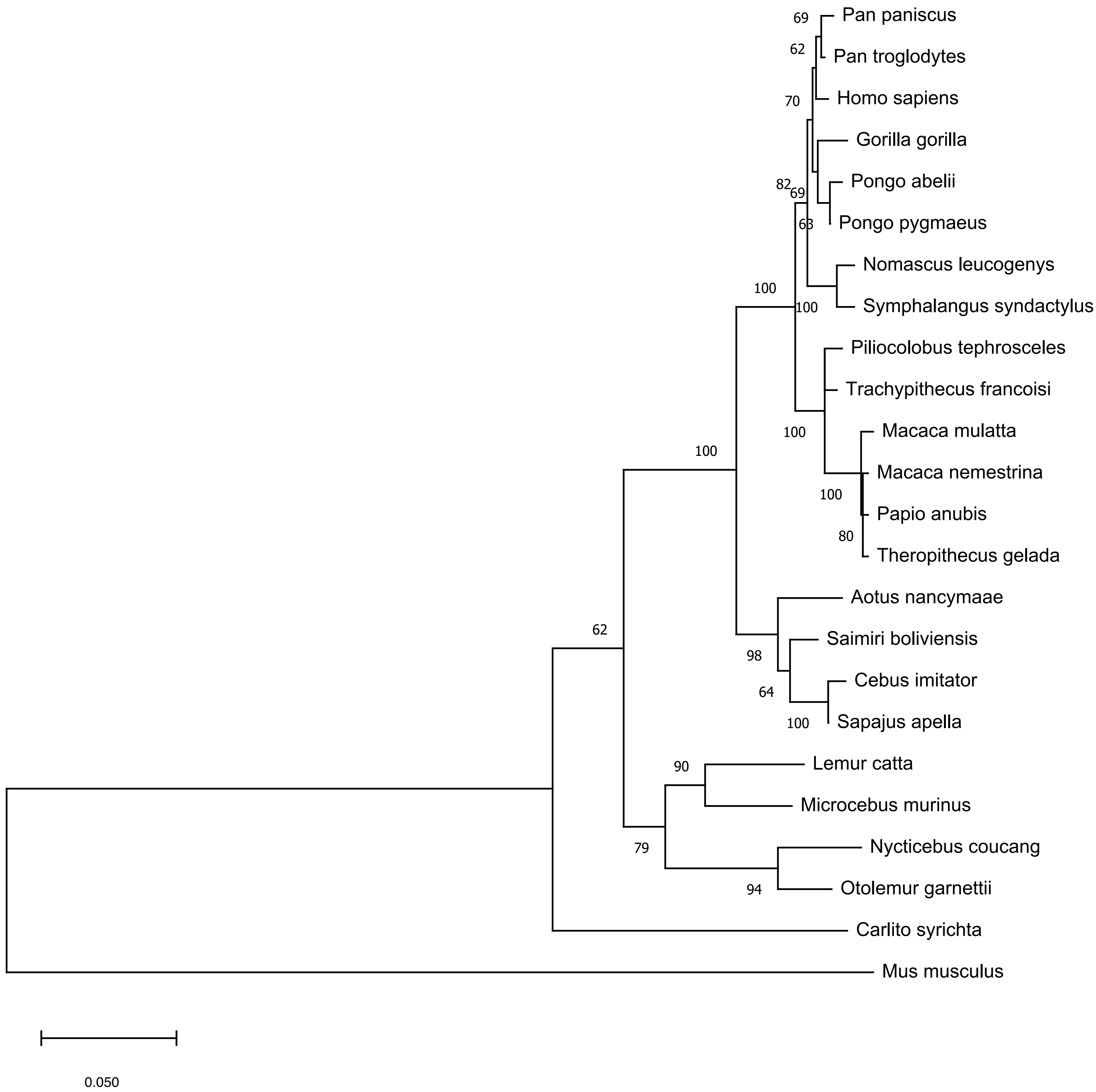
Pan paniscus
Pan troglodytes
Homo sapiens
Gorilla gorilla
Pongo abelii
Pongo pygmaeus
Nomascus leucogenys
Symphalangus syndactylus
Piliocolobus tephrosceles
Trachypithecus francoisi
Macaca mulatta
Macaca nemestrina
Papio anubis
Theropithecus gelada
Aotus nancymaae
Saimiri boliviensis
Cebus imitator
Sapajus apella
Lemur catta
Microcebus murinus
Nycticebus coucang
Otolemur garnettii
Carlito syrichta
Mus musculus
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Mus_musculus                  MFRLKTLPLL IFLHTQLANA FPVPEHLEEK NIKTAE---- ------NYLR KFYNLPSNQF RSSRN--ATM
Aotus_nancymaae               MFCLKTLPFL LLLHVQISKA FPVSS--KEK DTKIVQ---- ------DYLE KFYQLPSNQY QSIRKNSINM
Carlito_syrichta              MFSLQMLLFL LLLHMQVATA FPTPS--EEK STTMVQ---- ------DYLE KFYQLPSSRY RSARKNSTSM
Cebus_imitator                MFCLKTLPFL LLLHVQISKA FPVSS--KEK DTKIVQ---- ------DYLE KFYQLPSNQH QSIRKNSINM
Gorilla_gorilla               MFSLKTLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- ------DYLE KFYQLPSNQY QSTRKNGTNV
Lemur_catta                   MFYLKTLPFL LLLHMELSKA FPVPS--EEK NAKIVQ---- ------DYLE KFYRLPSNQY RTARKNSPST
Macaca_mulatta                MFSLKMLLFL LLLHVQISKA FPVSS--KEE NTKIVQ---- ------DYLE KFYQLPSNQY QSTRKNGTSM
Macaca_nemestrina             ---------- -------MQQ IP-------- QEKSIN---- ------DYLE KFYQLPSNQY QSTRKNGTSM
Microcebus_murinus            MFCLKTLPLL LLLHMELSKA FPVPS--EGR NAKIVQ---- ------DYLE KFYRLPSNQY RTARKNSASM
Nomascus_leucogenys           MFALKTLPFL LLLHVHISKA FPVSS--KEK NTKIVQ---- ------DYLE KFYQLPSNQY QSTRKNGTNV
Nycticebus_coucang            MFCLKTLLFL LLLHVQLSKT FPVVS--AEK NTKLIQ---- ------DYLE KFYQLPSNRY RTSRKNSTTM
Otolemur_garnettii            MFRLKTLVFL LLLHVPLSKT FPVVS--AEK NTKLIQ---- ------DYLE KFYQLPSNRY RTSRKNSTTM
Pan_paniscus                  MFSLKTLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- ------DYLE KFYQLPSNQY QSTRKNGTNV
Pan_troglodytes               MFSLKMLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- ------DYLE KFYQLPSNQY QSTRKNGTNV
Papio_anubis                  MFSLKMLPFL LLLHVQISKA FPVSS--KEE NTKIVQ---- ------DYLE KFYQLPSNQY QSMRKNGTSM
Piliocolobus_tephrosceles     MFSLKTLPFL FLLHVQISKA FPVSS--KEE NTKIVQ---- ------DYLE KFYQLPSNQY QSTRKNGTSM
Pongo_abelii                  MFSLKTLPFL LLLHVQISKA FPVSS--KEK NTKIVQ---- ------DYLE KFYQLPSNQY QSTRKNGTNV
Pongo_pygmaeus                -MCRFPRPFL YLLKRKIQKL FSTRP--SQK PTRCSHLILD FPASKIDYLE KFYQLPSNQY QSTRKNGTNV
Saimiri_boliviensis           MFCLKRLPFL LLLHVQISKA FPVSF--KEK DTKIVQ---- ------DYLE KFYQLPSNQY QSIRKNSINM
Sapajus_apella                MFCLKTLPFL LLLHVQISKA FPVSS--KEK DTKIVQ---- ------DYLE KFYQLPSNQY QSIRKNSINM
Symphalangus_syndactylus      MFALKTLPFL LLLHVHISKA FPVSS--KEK NTKIVQ---- ------DYLE KFYQLPSNQY QSTRKNGTNV
Theropithecus_gelada          MFSLKMLPFL LLLHVQISKA FPVSS--KEE NTKIVQ---- ------DYLE KFYQLPSNQY QSTRKNGTSM
Trachypithecus_francoisi      MFSLKTLPFL LLLHVQISKA FPLSS--KEE NTKIVQ---- ------DYLE KFYQLPSNQY QSTRKNGTSM
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                             71
Homo_sapiens                 IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGG FMLTPGNPKW ERTNLTYRIR NYTPQLSEAE
Mus_musculus                 VAEKLKEMQR FFSLAETGKL DAATMGIMEM PRCGVPDSGD FLLTPGSPKW THTNLTYRII NHTPQLSRAE
Aotus_nancymaae              IVEKLKEMQR FFGLNVTGKP NAETLEMMKQ PRCGVPDSGD FMITPGNPKW EQTNLTYRII NYTPQLSETE
Carlito_syrichta             IVEKLKEMQR FFGLNVTGKP DAETLETMEK PRCGVPDRGD FMLTPGNPKW KHTNLTYRII NYTPQLSEAD
Cebus_imitator               IVEKLKEMQQ FFGLNVTGKP NAETLEMMKQ PRCGVPDSGD FMITPGNPKW EQTNLTYRII NYTPQLSETE
Gorilla_gorilla              IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGG FMLTPGNPKW EHTNLTYRIR NYTPQLSVAE
Lemur_catta                  IVEKLKEMQR FFRLNVTGKP DAETLEVMEK PRCGVPDSGD FAITPGNPKW EHTNLTYRII SYTQQLSEAD
Macaca_mulatta               IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMLTPGNPKW ERTNLTYSIL NYTPQLSETD
Macaca_nemestrina            IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMLTPGNPKW ERTNLTYSIL NYTPQLSETD
Microcebus_murinus           VVEKLKEMQR FFGLNVTGKP DAETLEVMEK PRCGVPDSSS FMITPGSPKW EHTNVTYRII SHTQQLSVAE
Nomascus_leucogenys          IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMITPGNPKW ERTNLTYRIR NYTPQLSKAD
Nycticebus_coucang           IVEKLKEMQR FFGLNVTGKP NAETLEMMEK PRCGVPDTAG FVLTPGNPKW EHINLTYRFI NYTPQLSKTD
Otolemur_garnettii           IVEKLKEMQR FFGLNVTGKP NAETLEMMEK PRCGVPDTAG FMLTPGSPKW EHTNLTYRFI NYTPQLSKTD
Pan_paniscus                 IIEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGG FMLTPGNPKW ERTNLTYRIR NYTPQLSEAE
Pan_troglodytes              IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGG FMLTPGNPKW EHTNLTYRIR NYTPQLSEAE
Papio_anubis                 IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMLTPGNPKW EHTNLTYRIL NYTPQLSETD
Piliocolobus_tephrosceles    IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDTGD FMLTPGNPKW KHTNLTYSIL NYTPQLSQTD
Pongo_abelii                 IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGE FMLTPGNPKW ERTNLTYRIR NYTPQLSEDD
Pongo_pygmaeus               IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGE FMLTPGNPKW ERTNLTYRIR NYTPQLSEDD
Saimiri_boliviensis          IVEKLKEMQR FFGLNVTGKP DAETLEMMKQ PRCGVPDSGD FMITPGNPKW EQTNLTYRFI NYTPQLSVTE
Sapajus_apella               IVEKLKEMQQ FFGLNVTGKP NAETLEMMKQ PRCGVPDSGD FMITPGNPKW EQTNLTYRII NYTPQLSETE
Symphalangus_syndactylus     IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMITPGNPKW ERTNLTYRIR NYTPQLSKTD
Theropithecus_gelada         IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDSGD FMLTPGNPKW ERTNLTYRIL NYTPQLSETD
Trachypithecus_francoisi     IVEKLKEMQR FFGLNVTGKP NEETLDMMKK PRCGVPDTGD FMLTPGNPKW KHTNLTYSIL NYTPQLSKTD
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Homo_sapiens               VERAIKDAFE LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Mus_musculus               VKTAIEKAFH VWSVASPLTF TEILQGEADI NIAFVSRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDS
Aotus_nancymaae            VETAIGNAFK VWSNASSLTF TRISQGEANI SIAFFHRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDA
Carlito_syrichta           VDSAIERAFE LWSHASPLRF TRISQGEPDI KIAFVQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Cebus_imitator             VERAIGDAFK VWSDVSPLTF TRISQGEADI NIAFYQKDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Gorilla_gorilla            VERAIKDAFE LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Lemur_catta                VETAIEKAFK VWSDVSPLTF TRISRGEADI KIAFYLRDHG DNSPFDGPNG ILAHAFQPGR GIGGDVHFDA
Macaca_mulatta             VEGAIKKAFE VWSKASPLTF TRISQGQADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Macaca_nemestrina          VEGAIKKAFE VWSKASPLTF TRISQGQADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Microcebus_murinus         VGAAFEKAFK LWSGASPLTF TRISQGEADI KIAFVQRDHG DNSPFDGPNG ILAHAFQPGP GIGGDVHFDA
Nomascus_leucogenys        VERAIEKAFK VWSDASPLTF TRISQGEADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Nycticebus_coucang         VETVIEKAFE VWSKASPLTF TKISQGEADI KIAFVRREHG DNSPFDGPNG ILAHAFQPGR GIGGDVHFDE
Otolemur_garnettii         VETVIEKAFE VWSKASPLTF TKTAQGEADI KIAFVQKDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDE
Pan_paniscus               VERAIKDAFK LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Pan_troglodytes            VERAIKDAFE LWSVASPLIF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Papio_anubis               VEGAIKKAFE VWSKASPLTF TRISQGQADI NIGFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Piliocolobus_tephrosceles  VEGTIKKAFE VWSKVSPLTF TRISQGDADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Pongo_abelii               VKTAIEKAFE VWSKASPLTF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDA
Pongo_pygmaeus             VKTAIEKAFE VWSKASPLTF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDVHFDA
Saimiri_boliviensis        VETAIGNAFK IWSDPSPLTF TRISQGEADI NIAFFPRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Sapajus_apella             VETAIGDAFK VWSDVSPLTF TRISQGEADI NIAFYQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Symphalangus_syndactylus   VERAIEKAFK VWSDASPLTF TRISQGEADI NIAFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Theropithecus_gelada       VEGAIKKAFE VWSKASPLTF TRISQGQADI NIGFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
Trachypithecus_francoisi   IEGAIKKAFE VWSKVSPLTF TRISQGEADI NIGFFQRDHG DNSPFDGPNG ILAHAFQPGQ GIGGDAHFDA
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Mus_musculus                 EETWTQDSKN YNLFLVAAHE FGHSLGLSHS TDPGALMYPN YAYREPSTYS LPQDDINGIQ TIYGPSDNPI
Aotus_nancymaae              EETWTSTSKN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYS LPQDDINGIQ AIYGPSSNPI
Carlito_syrichta             EETWTKTSAN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYL LPQDDINGIQ AIYGPSDNPI
Cebus_imitator               EETWTNTSEN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYS LPQDDINGIQ AIYGPSSNPI
Gorilla_gorilla              EETWTNTSAS YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDIDGIQ AIYGLSSNPI
Lemur_catta                  EETWTTNANN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFREPSTYT LPQDDINGIQ AIYGPSSNPV
Macaca_mulatta               EETWTKTSTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Macaca_nemestrina            EETWTKNSTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Microcebus_murinus           EETWTTNFNN YNLFLVAAHE FGHSLGLAHS SDAGALMYPN YAFSEPSTYT LPQDDINGIQ AIYGPSNNPI
Nomascus_leucogenys          EETWTKTSTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSTYS LPQDDIDGIQ AIYGPSSNPI
Nycticebus_coucang           EETWTTTAVN YNLFLVAAHE FGHSLGLSHS TDPGALMYPN YAFNDPSTYS LPQDDINGIQ AIYGPSSSPV
Otolemur_garnettii           EETWTTTSIN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFNEPSTYS LPQDDINGIQ AIYGPSNSPV
Pan_paniscus                 EETWTDTSAN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDIDGIQ AIYGLSSNPI
Pan_troglodytes              EETWTDTSAN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDIDGIQ AIYGLSSNPI
Papio_anubis                 EETWTKDFTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Piliocolobus_tephrosceles    EETWTTNSTN YNLFLVAAHE FGHSLGLAHS FDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Pongo_abelii                 EETWTKTSAN YNLFIVAAHE FGHSLGLAHS SDPGALMYPN YAFTETSNYS LPQDDIDGIQ AIYGPSSNPV
Pongo_pygmaeus               EETWTKTSAN YNLFIVAAHE FGHSLGLAHS SDPGALMYPN YAFTETSNYS LPQDDIDGIQ AIYGPSSNPV
Saimiri_boliviensis          EETWTSTSEN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYS LPQDDINGIQ AIYGPSSNPI
Sapajus_apella               EETWTNTPEN YNLFLVAAHE FGHSLGLSHS SDPGALMYPN YAFREPSTYS LPQDDINGIQ AIYGPSSNPI
Symphalangus_syndactylus     EETWTKTSAN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSTYS LPQDDIDGIQ AIYGPSSNPI
Theropithecus_gelada         EETWTKDFTN YNLFLVAAHE FGHSLGLAHS SDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
Trachypithecus_francoisi     EETWTTNSTN YNLFLVAAHE FGHSLGLAHS FDPGALMYPN YAFRETSNYS LPQDDINGIQ AIYGPSSNPI
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                                281
Homo_sapiens                    QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Mus_musculus                    QPTGPSTPKA CDPHLRFDAT TTLRGEIYFF KDKYFWRRHP QLRTVDLNFI SLFWPFLPNG LQAAYEDFDR
Aotus_nancymaae                 QPTGPSTPRP CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Carlito_syrichta                QPTGPSTPRT CDPRLTFDAI TTLRGEIFFF RDKYFWRRHP QLRSIEFNFI SLFWPALPDS IQAAYEDLDR
Cebus_imitator                  QPTGPSTPRP CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Gorilla_gorilla                 QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Lemur_catta                     QPTGPSTPRS CDPRLTFDAI TTLRGEILFF KDKYFWRRHP QLRSVELNFI SLFWPNLPNG IQAAYEDFDR
Macaca_mulatta                  QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Macaca_nemestrina               QPTGPTTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Microcebus_murinus              QPTGPSTPMA CDPRLTFDAI TTLRGEIFFF KDKYFWRRHP QLRSVELNFI SLFWPSLPNG IQAAYEDFDK
Nomascus_leucogenys             QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDSDR
Nycticebus_coucang              QPTGPSTPRT CDPRLTFDAI TTLRGEILFF KDKYFWRKHP QLPTVELNFI SLFWPSLPNG IQAAYEDFDR
Otolemur_garnettii              QPTGPSTPRT CDPRLTFDAI TTLRGEILFF KDKYFWRKHP QLPTAELNFI SLFWPSLPNG IQAAYEDFER
Pan_paniscus                    QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Pan_troglodytes                 QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDRYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Papio_anubis                    QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Piliocolobus_tephrosceles       QPTGPSTPES CDPRLTFDAI TTLRGEILFF KDEYFWRRHP WLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Pongo_abelii                    QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRIEMNFI SLFWPSLPTG MQAAYEDFDR
Pongo_pygmaeus                  QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRIEMNFI SLFWPSLPTG MQAAYEDFDR
Saimiri_boliviensis             QPTGPSTPRS CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLRRVEMNFI SLFWPSLPTG IQAAYEDFDR
Sapajus_apella                  QPTGPSTPRP CDPSLTFDAI TTLRGEIFFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Symphalangus_syndactylus        QPTGPSTPKP CDPSLTFDAI TTLRGEILFF KDKYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
Theropithecus_gelada            QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP HLQSVEMNFI SLFWPSLPTG IQAAYEDFDR
Trachypithecus_francoisi        QPTGPSTPKS CDPRLTFDAI TTLRGEILFF KDEYFWRRHP QLQRVEMNFI SLFWPSLPTG IQAAYEDFDR
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Homo_sapiens                   DLIFLFKGNQ YWALSGYDIL QGYPKDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Mus_musculus                   DLVFLFKGRQ YWALSGYDLQ QGYPRDISNY GFPRSVQAID AAVSYNGKTY FFINNQCWRY DNQRRSMDPG
Aotus_nancymaae                DLVFLFKGNQ YWALSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Carlito_syrichta               DLVFLFKGNQ YWAMNGYDLQ PGYPRDISNY GFPSNVQAID AAVYFRSKTY FFVNDQFWRY DNERQTMEPG
Cebus_imitator                 DLVFLFKGNQ YWALSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQLMEPG
Gorilla_gorilla                DLIFLFKGNQ YWALSGYDIL QGYPKDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Lemur_catta                    DLVFLFKGNQ YWALSGYDIQ QGYPRYISNY GFPSTVQAID AAVSYGSETY FFVNDQFWRY DNQRQAMDPG
Macaca_mulatta                 DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Macaca_nemestrina              DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Microcebus_murinus             DLVFLFKGNQ YWAMSGYDIQ QGYPRHISNY GFPSNVQAID AAVSYGRKTY FFVNDQLWRY DNQRQAMDPG
Nomascus_leucogenys            DLIFLFKGNQ YWALSGYDIQ QGYPKSISNY GFPCSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Nycticebus_coucang             DLVFLFKGNQ YWALNGYDIQ EGYPRDISNY GFPSTVQAID AAVSYRRKTY FFVNDQFWRY DNQRQLMEPG
Otolemur_garnettii             DLVFLFKGNQ YWALNGYEIQ QGYPRDISNY GFPSTVQAVD AAVFYRRKTY FFVNDQFWRY DNQRQFMEPG
Pan_paniscus                   DLIFLFKGNQ YWALSGYDIL QGYPKDIANY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Pan_troglodytes                DLIFLFKGNQ YWALSGYDIL QGYPKDIANY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Papio_anubis                   DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Piliocolobus_tephrosceles      DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Pongo_abelii                   DLIFLFKGNQ YWALSGYDIL QGYPKNISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Pongo_pygmaeus                 DLIFLFKGNQ YWALSGYDIL QGYPKNISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Saimiri_boliviensis            DLVFLFKGNQ YWALSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYKSKTY FFVNDQFWRY DNQRQFMEPG
Sapajus_apella                 DLVFLFKGNQ YWALSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQLMEPG
Symphalangus_syndactylus       DLIFLFKGNQ YWALSGYDIQ QGYPKSISNY GFPCSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Theropithecus_gelada           DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
Trachypithecus_francoisi       DLIFLFKGNQ YWAVSGYDIQ QGYPRDISNY GFPSSVQAID AAVFYRSKTY FFVNDQFWRY DNQRQFMEPG
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Mus_musculus                  YPKSIPSMFP GVNCRVDAVF LQDSFFLFFS GPQYFAFNFV SHRVTRVARS NLWLNCS--
Aotus_nancymaae               YPQSISYIFP GIESKVDAVF QQEHFFLFFS GPLYYAFDLS AQRVTRVARG NKWLNCR--
Carlito_syrichta              YPKSTLSIFP GIESKVDAVF QQNYFFFFFS GPRFYAFDLQ AHRVTRVDRS NRWLNCR--
Cebus_imitator                YPQRISDIFP GIERKVDAVF QQEHFFLFFS GPIYYAFDLS AQRVTRVARG NKWLNCR--
Gorilla_gorilla               YPKSISGAFP GIESKVDAVF QQQHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Lemur_catta                   YPQSILRTFP GIQSKVDAVF QKDDFFLFFS GPLYYAFNLS TRRVTRIDRS NKWLNCR--
Macaca_mulatta                YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Macaca_nemestrina             YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Microcebus_murinus            YPQSISSTFP GIQSRVDAVF QQDDFFLFFS GPRYYAFNLS TNRVTRLDKS NKWLNCR--
Nomascus_leucogenys           YPKSISGTFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVERG NKWLNCRYG
Nycticebus_coucang            YPKSLSTAFP GIESRVDAVF QRDYVFLFFS GPRYYAFDLN TRRVIRIDRS NIWLNCR--
Otolemur_garnettii            YPKSISTAFP GIESRVDAVF HRDYVFVFFS GPRYYAFDLN TRRVIRIDRS NKWLNCR--
Pan_paniscus                  YPKSISGAFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Pan_troglodytes               YPKSISGAFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Papio_anubis                  YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Piliocolobus_tephrosceles     YPKSTSGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTTVARA NEWLNCRYS
Pongo_abelii                  YPKSISDTFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCRYG
Pongo_pygmaeus                YPKSISDTFP GIESKVDAVF QQEHFFLFFS GPRYYAFDLI AQRVTRVARG NKWLNCR--
Saimiri_boliviensis           YPQSISGIFP GIESKVDAVF QQEHFFLFFS GPIYYAFDLS AQRVTKIARG NKWLNCR--
Sapajus_apella                YPQRISDIFP GIERKVDAVF QQEHFFLFFS GPIYYAFDLS AQRVTRVARG NKWLNCR--
Symphalangus_syndactylus      YPKSISDTFP GIESKVDAVF QQERFFLFFS GPRYYAFDLI AQRVTRVERG NKWLNCRYG
Theropithecus_gelada          YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
Trachypithecus_francoisi      YPKSISGTFP GIENKVDAVF QQEHFFLFFS GPRYYAFDLI AERVTRVARA NKWLNCRYS
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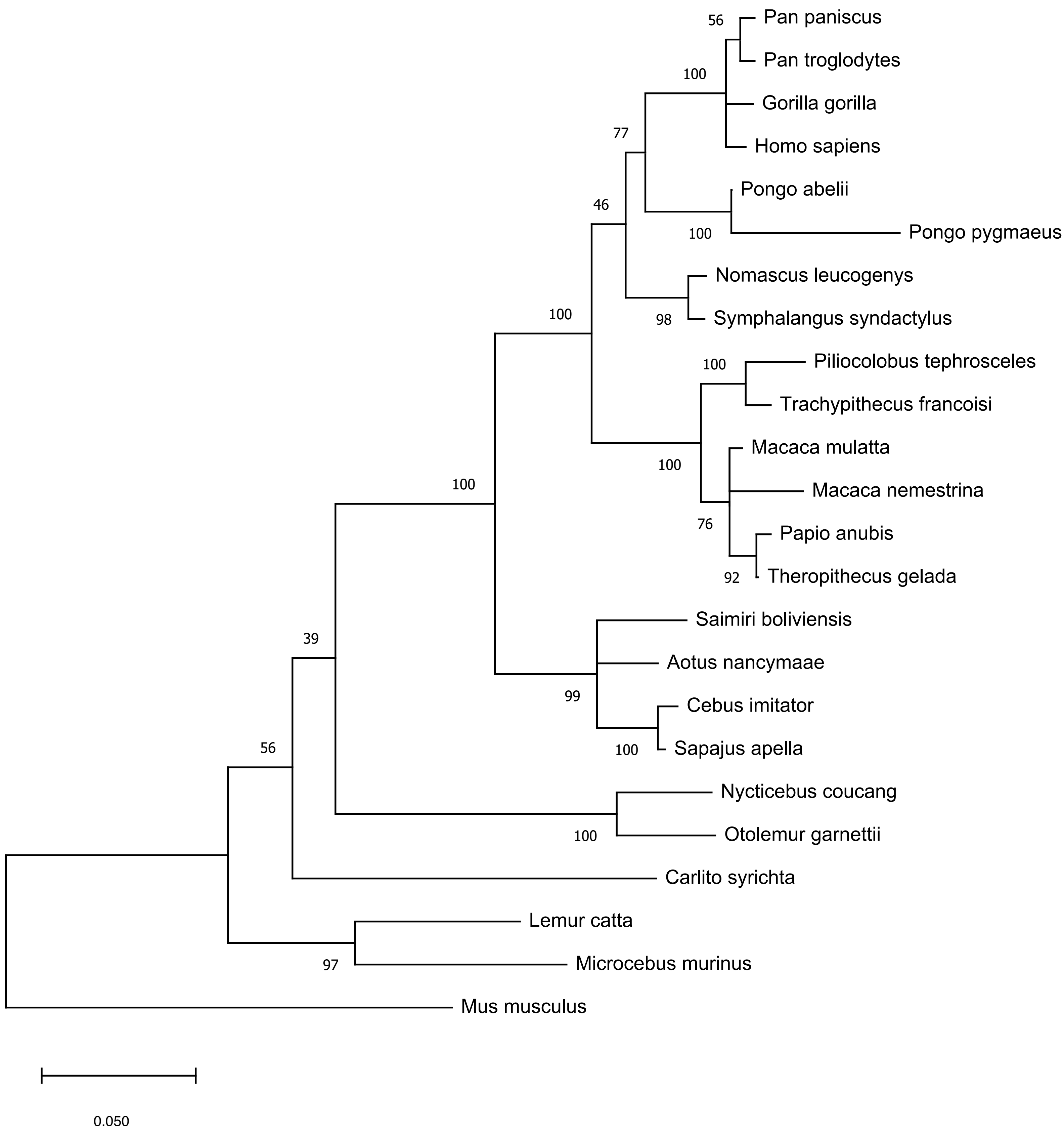
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Pan paniscus
Pan troglodytes
100
Gorilla gorilla
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Homo sapiens
Pongo abelii
46
100
Pongo pygmaeus
Nomascus leucogenys
100
98
Symphalangus syndactylus
100
Piliocolobus tephrosceles
Trachypithecus francoisi
Macaca mulatta
100
100
Macaca nemestrina
76
Papio anubis
92
Theropithecus gelada
Saimiri boliviensis
39
Aotus nancymaae
99
Cebus imitator
56
100
Sapajus apella
Nycticebus coucang
100
Otolemur garnettii
Carlito syrichta
Lemur catta
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Microcebus murinus
Mus musculus
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Mus_musculus                    MHSAILATFF LLSWTPCWSL PLPYGDDDDD DLSEEDLVFA EHYLKSYYHP ATLAGILKKS TVTSTVDRLR
Aotus_nancymaae                 MHLGVLAAFL FLNWTHCRAL PLPNG-DDED DLSEEDLQFA ERYLKLYYHP TNLAGILKKN SANSMADRLR
Carlito_syrichta                MHPGVLTAFL LLCWTQCQSL PLPNG-EDED DTSEEDLQFA ERYLRSFYHP VNLAGILKKN AASSMVDRLR
Cebus_imitator                  MHPGVLAAFL FLSWTHCWAL PLPNG-DDED DLSEEDLQFA ERYLKLYYHP TNLAGILKKN SASSMTDRLR
Gorilla_gorilla                 MHPGVLAAFL FLSWTHSRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Lemur_catta                     MHPGILVAFL FLSWTHCRSL PLPNG--DDD DLSEEDLQFA ERYLKSYYHP PNLAGILKET SASSMVDRLR
Macaca_mulatta                  MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Macaca_nemestrina               MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Microcebus_murinus              -MQGVLVAFL FLSWTHCRSL PLPDG--DDD DLSEEDLQFA ERYLKSYYHP PILAGILKKT SASSMVDRLR
Nomascus_leucogenys             MHPGILAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Nycticebus_coucang              MLPGVLLAFL FLSWTHCRAL PLPND-DDDD DLSEEDLQFA ERYLKSYYYP PNLAGILKKT SASSMIDRLR
Otolemur_garnettii              MLPRVLLAFL FLSWTPCRAL PLPNG--DDD DLSEEDLQFA EHYLKSYYHP LNLAGILKKT SASSMIDRLR
Pan_paniscus                    MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTERLR
Pan_troglodytes                 MHPGVLAAFL FLSWAHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTERLR
Papio_anubis                    MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Piliocolobus_tephrosceles       MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Pongo_abelii                    MHPGVLAAFL FLSWTHCRAL PLPSD-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Pongo_pygmaeus                  MHPGVLAAFL FLSWTHCRAL PLPSD-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Saimiri_boliviensis             MHPGVLAAFL FLSWTHCRAL PLPNG-DDED DLSEEDLQFA ERYLKLYYHP TNLAGILKKN SASSMTDRLR
Sapajus_apella                  MHPGVLAAFL FLSWTHCWAL PLPNG-DDED DLSEEDLQFA EHYLKLYYHP TNLAGILKKN SASSMTDRLR
Symphalangus_syndactylus        MHPGILAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYHP TNLAGILKEN AASSMTDRLR
Theropithecus_gelada            MHPGVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
Trachypithecus_francoisi        MHPVVLAAFL FLSWTHCRAL PLPSG-GDED DLSEEDLQFA ERYLRSYYYP TNLAGILKEN AASSMTDRLR
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Homo_sapiens                 EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Mus_musculus                 EMQSFFGLEV TGKLDDPTLD IMRKPRCGVP DVGEYNVFPR TLKWSQTNLT YRIVNYTPDM SHSEVEKAFR
Aotus_nancymaae              EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Carlito_syrichta             EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIENYTPDM PHSEVEKAFK
Cebus_imitator               EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWPKMNLT YRIVNYTPDM THSEVEKAFK
Gorilla_gorilla              EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Lemur_catta                  EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWTQTNLT YRIVNYTPDM PHSEVEKAFK
Macaca_mulatta               EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Macaca_nemestrina            EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Microcebus_murinus           EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWTQTNLT YRIVNYTPDM THSEVEKAFK
Nomascus_leucogenys          EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Nycticebus_coucang           EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWTKTNLT YRIVNYTPDM THSEVEKAFK
Otolemur_garnettii           EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWTKTNLT YRIVNYTPDM THSEVEKAFK
Pan_paniscus                 EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Pan_troglodytes              EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
Papio_anubis                 EMQSFFGLEV TGKLDDNTLD VMKKPRCGVP DVGEYNVFPR TLKWSKMNLT YRIVNYTPDM THSEVEKAFK
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Trachypithecus_francoisi     EMQSFFGLEV TGKLDDNTLD IMKKPRCGVP DVGEYNVFPR TLKWSKVNLT YRIVNYTPDM THSEVEKAFK
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Mus_musculus                KAFKVWSDVT PLNFTRIYDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Aotus_nancymaae             KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Carlito_syrichta            KAFKVWSDVT PLNFTRMHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Cebus_imitator              KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Gorilla_gorilla             KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Lemur_catta                 KAFKVWSDVT PLNFTRLHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Macaca_mulatta              KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Macaca_nemestrina           KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Microcebus_murinus          KAFKVWSDVT PLNFTRLHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNLGGDA HFDDDETWTS
Nomascus_leucogenys         KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Nycticebus_coucang          KAFKVWSDVT PLNFTRLHDG TADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Otolemur_garnettii          KAFKVWADVT PLNFTRLHDG TADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pan_paniscus                KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pan_troglodytes             KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Papio_anubis                KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Piliocolobus_tephrosceles   KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pongo_abelii                KAFKVWSDVT PLNFTRLHNG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Pongo_pygmaeus              KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Saimiri_boliviensis         KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Sapajus_apella              KAFKVWSDVT PLNFTRLHDG IADIMISFGI KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Symphalangus_syndactylus    KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Theropithecus_gelada        KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
Trachypithecus_francoisi    KAFKVWSDVT PLNFTRLHDG IADIMISFGT KEHGDFYPFD GPSGLLAHAF PPGPNYGGDA HFDDDETWTS
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                              211
Homo_sapiens                  SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Mus_musculus                  SSKGYNLFIV AAHELGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQFLYGPG DEDPNPKHPK
Aotus_nancymaae               SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQFLYGPG DEDPNPKHPK
Carlito_syrichta              SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK NHFVLPDDDV QGIQTLYGPG DEDPNPKHPK
Cebus_imitator                SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTSK SHFMLPDDDV QGIQFLYGPG DEDPNPKHPK
Gorilla_gorilla               SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Lemur_catta                   SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFVLPDDDV QGIQSLYGPG DEDPNPKHPK
Macaca_mulatta                SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Macaca_nemestrina             SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Microcebus_murinus            SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFVLPDDDV QGIQSLYGPG DEDPNPKHPK
Nomascus_leucogenys           SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Nycticebus_coucang            SSKGYNLFLV AAHELGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPEDDV QGIQFLYGPG DEDPNPKHPK
Otolemur_garnettii            SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFVLPEDDV QGIQSLYGPG DEDPNPKHPK
Pan_paniscus                  SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Pan_troglodytes               SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Papio_anubis                  SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFVLPDDDV QGIQSLYGPG DEDPNPKHPK
Piliocolobus_tephrosceles     SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Pongo_abelii                  SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Pongo_pygmaeus                SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Saimiri_boliviensis           SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTSK NHFMLPDDDV QGIQFLYGPG DEDPNPKHPK
Sapajus_apella                SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTSK SHFMLPDDDV QGIQFLYGPG DEDPNPKHPK
Symphalangus_syndactylus      SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
Theropithecus_gelada          SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFVLPDDDV QGIQSLYGPG DEDPNPKHPK
Trachypithecus_francoisi      SSKGYNLFLV AAHEFGHSLG LDHSKDPGAL MFPIYTYTGK SHFMLPDDDV QGIQSLYGPG DEDPNPKHPK
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                            281
Homo_sapiens                TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Mus_musculus                TPEKCDPALS LDAITSLRGE TMIFKDRFFW RLHPQQVEAE LFLTKSFWPE LPNHVDAAYE HPSRDLMFIF
Aotus_nancymaae             TPDKCDPSLS LDAITSLRGE TMVFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSRDLIFIF
Carlito_syrichta            TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSRDLIFIF
Cebus_imitator              TPDKCDPSLS LDAITSLRGE TMVFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Gorilla_gorilla             TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSYDLIFVF
Lemur_catta                 TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPAHDLVFVF
Macaca_mulatta              TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Macaca_nemestrina           TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Microcebus_murinus          TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLVFFF
Nomascus_leucogenys         TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Nycticebus_coucang          TPDKCDPSLS LDAITSLRGE TIIFKDRFFW RLHPQQVDAE LFLTKSFWME LPNRIDAAYE HPSHDLVFIF
Otolemur_garnettii          TPDKCDPSLS LDAITNLRGE TIIFKDRFFW RLHPQQVDAE LFLTKSFWLE LPNRIDAAYE HPSHDLVFIF
Pan_paniscus                TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Pan_troglodytes             TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Papio_anubis                TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Piliocolobus_tephrosceles   TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Pongo_abelii                TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Pongo_pygmaeus              TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Saimiri_boliviensis         TPDKCDPSLS LDAITSLRGE TMVFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Sapajus_apella              TPDKCDPSLS LDAITSLRGE TMVFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Symphalangus_syndactylus    TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Theropithecus_gelada        TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
Trachypithecus_francoisi    TPDKCDPSLS LDAITSLRGE TMIFKDRFFW RLHPQQVDAE LFLTKSFWPE LPNRIDAAYE HPSHDLIFIF
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                              351
Homo_sapiens                  RGRKFWALNG YDILEGYPKK ISELGLPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Mus_musculus                  RGRKFWALNG YDILEGYPRK ISDLGFPKEV KRLSAAVHFE NTGKTLFFSE NHVWSYDDVN QTMDKDYPRL
Aotus_nancymaae               RGRKFWALNG YDILEGYPKK ISELGFPKEI KKISAAVHFE DTGRTLFFSG NHVWRYDDTN QIMDKDYPRL
Carlito_syrichta              RGRKFWALNG YDIMEGYPQK ISELGFPKEV KKISAAVHFE DTGKTLFFSG NQVWSYDDTN HVMDKDYPRF
Cebus_imitator                RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGRTLFFSG NQVWRYDDTN QIMDKDYPRL
Gorilla_gorilla               RGRKFWALNG YDILEGYPKK ISELGLPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Lemur_catta                   RGRKFWALNG YDIMEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLFFSG NQVWRYDDTN HIMDTDYPRL
Macaca_mulatta                RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Macaca_nemestrina             RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Microcebus_murinus            RGRKFWALNG YDIMEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLFFSG NQVWRYDDTN QIMDKDYPRL
Nomascus_leucogenys           RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Nycticebus_coucang            RGRKFWALNG YDIMEGYPKK ISELGFPKEV KKISAAVHFE DRGKTLFFSG NQVWSYDDTN HIMDKDYPRL
Otolemur_garnettii            RGRKFWALNG YDIMEGYPKK ISELGFPKEV KKISAAVHFE DRGKTLFFSG NQVWSYDDTN HIMDKDYPRL
Pan_paniscus                  RGRKFWALNG YDILEGYPKK ISELGLPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Pan_troglodytes               RGRKFWALNG YDILEGYPKK ISELGLPKEV KKISATVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Papio_anubis                  RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Piliocolobus_tephrosceles     RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Pongo_abelii                  RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Pongo_pygmaeus                RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Saimiri_boliviensis           RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLFFSG NQVWRYDDTN QIMDKDYPRL
Sapajus_apella                RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGRTLFFSG NQVWRYDDTN QIMDKDYPRL
Symphalangus_syndactylus      RGRKFWALNG YDILEGYPQK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Theropithecus_gelada          RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
Trachypithecus_francoisi      RGRKFWALNG YDILEGYPKK ISELGFPKEV KKISAAVHFE DTGKTLLFSG NQVWRYDDTN HIMDKDYPRL
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                                 421
Homo_sapiens                     IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Mus_musculus                     IEEEFPGIGN KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPTNSIL
Aotus_nancymaae                  IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSKRI VRVMPANSIL
Carlito_syrichta                 IEEVFPGIGD KVDAVYEKNG YIYFFNGPIQ FEF------- ---------- ---SVWSKRI VRVMTANSLL
Cebus_imitator                   IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSKRI VRVMPANSIL
Gorilla_gorilla                  IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Lemur_catta                      IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPTNSLL
Macaca_mulatta                   IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Macaca_nemestrina                IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Microcebus_murinus               IEEDFPGIGD KVDAVYEKNG YIYFFSGPIQ FEY------- ---------- ---SIWSNRI VRVMPTNSLL
Nomascus_leucogenys              IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Nycticebus_coucang               IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSDRI VRVMPTNALL
Otolemur_garnettii               IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPTNALL
Pan_paniscus                     IEEEFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Pan_troglodytes                  IEEEFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Papio_anubis                     IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Piliocolobus_tephrosceles        IEEDFPGIGD KVDAVYEKNG YIYFFNGPTQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Pongo_abelii                     IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Pongo_pygmaeus                   IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Saimiri_boliviensis              IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSKRI VRVMPANSIL
Sapajus_apella                   IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSKRI VRVMPANSIL
Symphalangus_syndactylus         IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
Theropithecus_gelada             IEEDFPGIGD KVDAVYEKNE SHFVVQAGVQ WHNLSSLQPP PPGFKRFSCL SLRSSWNYRL YLFFQRAHTV
Trachypithecus_francoisi         IEEDFPGIGD KVDAVYEKNG YIYFFNGPIQ FEY------- ---------- ---SIWSNRI VRVMPANSIL
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                                   491
Homo_sapiens                          WC
Mus_musculus                          WC
Aotus_nancymaae                       WC
Carlito_syrichta                      WC
Cebus_imitator                        WC
Gorilla_gorilla                       WC
Lemur_catta                           WC
Macaca_mulatta                        WC
Macaca_nemestrina                     LC
Microcebus_murinus                    WC
Nomascus_leucogenys                   WC
Nycticebus_coucang                    WC
Otolemur_garnettii                    WC
Pan_paniscus                          WC
Pan_troglodytes                       WC
Papio_anubis                          WC
Piliocolobus_tephrosceles             WC
Pongo_abelii                          WC
Pongo_pygmaeus                        WC
Saimiri_boliviensis                   WC
Sapajus_apella                        WC
Symphalangus_syndactylus              WC
Theropithecus_gelada                  --
Trachypithecus_francoisi              WC
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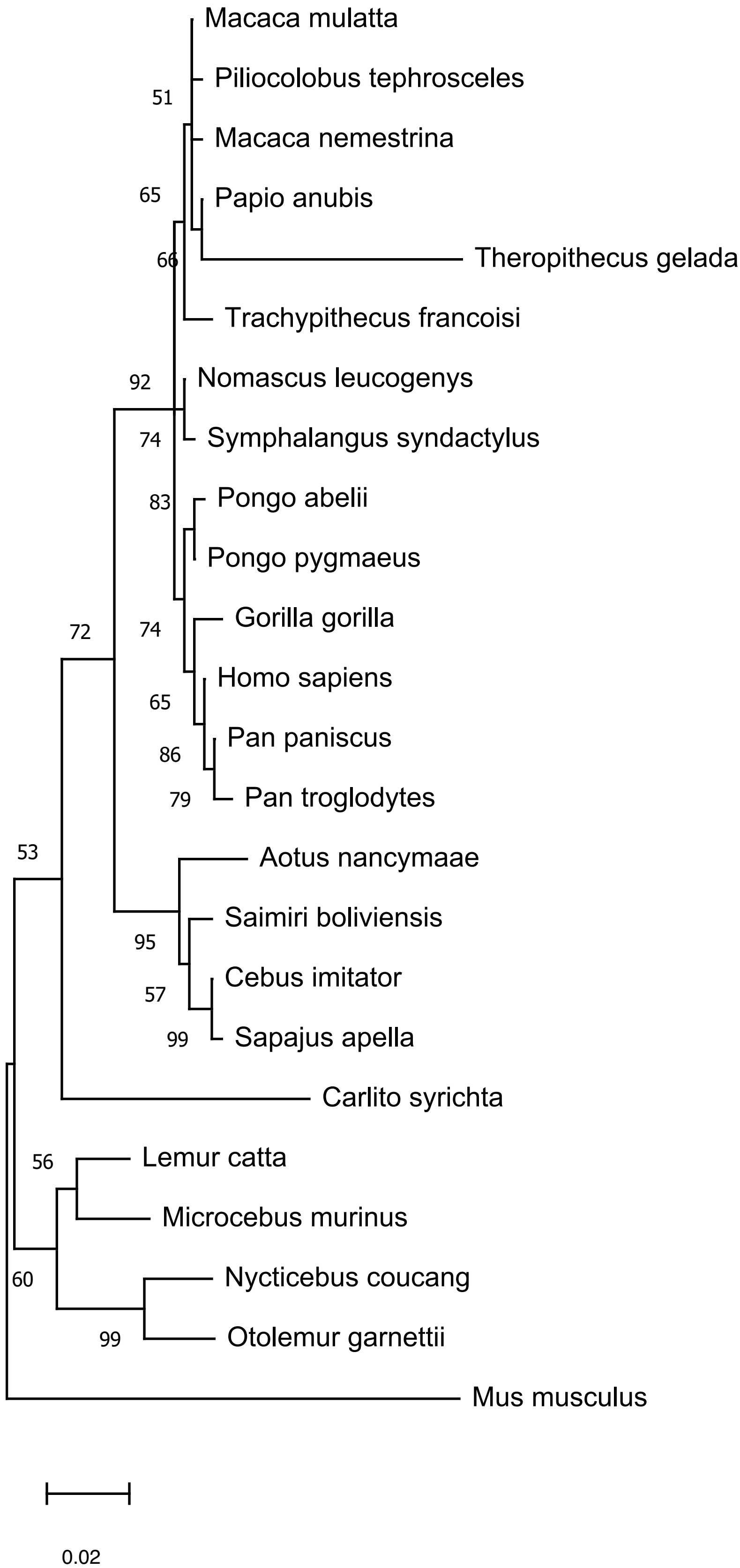

Macaca mulatta
Piliocolobus tephrosceles
Macaca nemestrina
Papio anubis
Theropithecus gelada
Trachypithecus francoisi
Nomascus leucogenys
Symphalangus syndactylus
Pongo abelii
Pongo pygmaeus
Gorilla gorilla
Homo sapiens
Pan paniscus
Pan troglodytes
Aotus nancymaae
Saimiri boliviensis
Cebus imitator
Sapajus apella
Carlito syrichta
Lemur catta
Microcebus murinus
Nycticebus coucang
Otolemur garnettii
Mus musculus
51
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A glimpse on the discussions…