GEPHE SUMMARY

Gephebase Gene
enamelin (ENAM) (https://www.gephebase.org/search-criteria?/and+Gene Gephebase=^enamelin (ENAM)^#gephebase-summary-title)

GepheID
GP00001939

Entry Status
Published

Main curator
Courtier

PHENOTYPIC CHANGE

Trait Category
Physiology (https://www.gephebase.org/search-criteria?/and+Trait Category=^Physiology^#gephebase-summary-title)

Trait
Tooth absence (no enamel production) (https://www.gephebase.org/search-criteria?/and+Trait=^Tooth absence (no enamel production)^#gephebase-summary-title)

Trait State in Taxon A
presence of teeth

Trait State in Taxon B
absence of teeth

Ancestral State
Taxon A

Taxonomic Status
Intergeneric or Higher (https://www.gephebase.org/search-criteria?/and+Taxonomic Status=^Intergeneric or Higher^#gephebase-summary-title)

Taxon A

Latin Name
Cetacea (https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=^Cetacea^#gephebase-summary-title)

Common Name
whales

Synonyms
whales; cetaceans; whale; whales, dolphins, and porpoises

Rank
order

Lineage
cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Deuterostomia; Chordata; Craniata; Vertebrata; Gnathostomata; Teleostomi; Euteleostomi; Sarcopterygii; Dipnotetrapodomorpha; Tetrapoda; Amniota; Mammalia; Theria; Eutheria; Boreoeutheria; Laurasiatheria; Cetartiodactyla

Parent
Cetartiodactyla (whales, hippos, ruminants, pigs, camels etc.) - (Rank: no rank) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 91561)

NCBI Taxonomy ID
9721 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 9721)

is Taxon A an Infraspecies?
No

Taxon B #1

Latin Name
Eubalaena glacialis (https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=^Eubalaena glacialis^#gephebase-summary-title)

Common Name
North Atlantic right whale

Synonyms
Balaena glacialis; North Atlantic right whale; northern right whale; Eubalaena glacialis (Mueller, 1776)

Rank
species

Lineage
cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Deuterostomia; Chordata; Craniata; Vertebrata; Gnathostomata; Teleostomi; Euteleostomi; Sarcopterygii; Dipnotetrapodomorpha; Tetrapoda; Amniota; Mammalia; Theria; Eutheria; Boreoeutheria; Laurasiatheria; Cetartiodactyla; Cetacea; Mysticeti; Balaenidae; Eubalaena

Parent
Eubalaena () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 27605)

NCBI Taxonomy ID
27606 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 27606)

is Taxon B an Infraspecies?
No

Taxon B #2

Latin Name
Megaptera novaeangliae (https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=^Megaptera novaeangliae^#gephebase-summary-title)

Common Name
humpback whale

Synonyms
humpback whale; Megaptera novaeanagliae

Rank
species

Lineage
cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Deuterostomia; Chordata; Craniata; Vertebrata; Gnathostomata; Teleostomi; Euteleostomi; Sarcopterygii; Dipnotetrapodomorpha; Tetrapoda; Amniota; Mammalia; Theria; Eutheria; Boreoeutheria; Laurasiatheria; Cetartiodactyla; Cetacea; Mysticeti; Balaenopteridae; Megaptera

Parent
Megaptera () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 9772)

NCBI Taxonomy ID

9773
(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 9773)

is Taxon B an Infraspecies?

No

Taxon B #3

Latin Name

Eschrichtius robustus
(https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=^Eschrichtius robustus^#gephebase-summary-title)

Common Name

grey whale

Synonyms

Balaenoptera robusta; Eschrichtius gibbosus; grey whale; California gray whale; gray whale

Rank

species

Lineage

cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Deuterostomia; Chordata; Craniata; Vertebrata; Gnathostomata; Teleostomi; Euteleostomi; Sarcopterygii; Dipnotetrapodomorpha; Tetrapoda; Amniota; Mammalia; Theria; Eutheria; Boreoeutheria; Laurasiatheria; Cetartiodactyla; Cetacea; Mysticeti; Eschrichtiidae; Eschrichtius

Parent

Eschrichtius () - (Rank: genus)
(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 9763)

NCBI Taxonomy ID

9764
(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 9764)

is Taxon B an Infraspecies?

No

Taxon B #4

Latin Name

Caperea marginata
(https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=^Caperea marginata^#gephebase-summary-title)

Common Name

pygmy right whale

Synonyms

pygmy right whale

Rank

species

Lineage

cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Deuterostomia; Chordata; Craniata; Vertebrata; Gnathostomata; Teleostomi; Euteleostomi; Sarcopterygii; Dipnotetrapodomorpha; Tetrapoda; Amniota; Mammalia; Theria; Eutheria; Boreoeutheria; Laurasiatheria; Cetartiodactyla; Cetacea; Mysticeti; Neobalaenidae; Caperea

Parent

Caperea () - (Rank: genus)
(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 27603)

NCBI Taxonomy ID

27604
(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 27604)

is Taxon B an Infraspecies?

No

GENOTYPIC CHANGE

Generic Gene Name

ENAM

Synonyms

ADAI; AI1C; AIH2

String

9606.ENSP00000379383
(http://string-db.org/newstring_cgi/show_network_section.pl?identifier=9606.ENSP00000379383)

Sequence Similarities

-

UniProtKB Homo sapiens

Q9NRM1 (http://www.uniprot.org/uniprot/Q9NRM1)

GenebankID or UniProtKB

()

GO - Molecular Function

GO:0030345 : structural constituent of tooth enamel (https://www.ebi.ac.uk/QuickGO/term/GO:0030345)

GO - Biological Process

GO:0044267 : cellular protein metabolic process (https://www.ebi.ac.uk/QuickGO/term/GO:0044267)
GO:0043687 : post-translational protein modification (https://www.ebi.ac.uk/QuickGO/term/GO:0043687)
GO:0031214 : biomineral tissue development (https://www.ebi.ac.uk/QuickGO/term/GO:0031214)
GO:0036305 : ameloblast differentiation (https://www.ebi.ac.uk/QuickGO/term/GO:0036305)
GO:0097186 : amelogenesis (https://www.ebi.ac.uk/QuickGO/term/GO:0097186)
GO:0070175 : positive regulation of enamel mineralization (https://www.ebi.ac.uk/QuickGO/term/GO:0070175)
GO:0022604 : regulation of cell morphogenesis (https://www.ebi.ac.uk/QuickGO/term/GO:0022604)

GO - Cellular Component

GO:0031012 : extracellular matrix (https://www.ebi.ac.uk/QuickGO/term/GO:0031012)
GO:0005788 : endoplasmic reticulum lumen (https://www.ebi.ac.uk/QuickGO/term/GO:0005788)

Presumptive Null

Yes (https://www.gephebase.org/search-criteria?/and+Presumptive Null=^Yes^#gephebase-summary-title)

Molecular Type

Coding (https://www.gephebase.org/search-criteria?/and+Molecular Type=^Coding^#gephebase-summary-title)

Aberration Type

Deletion (https://www.gephebase.org/search-criteria?/and+Aberration Type=^Deletion^#gephebase-summary-title)

Deletion Size

1-9 bp

Molecular Details of the Mutation

1-bp deletion. Various frameshift mutations were found in the distinct species.

Experimental Evidence

Candidate Gene (https://www.gephebase.org/search-criteria?/and+Experimental Evidence=^Candidate Gene^#gephebase-summary-title)

Main Reference

Molecular decay of the tooth gene Enamelin (ENAM) mirrors the loss of enamel in the fossil record of placental mammals. (2009) (https://pubmed.ncbi.nlm.nih.gov/19730686)

Authors

Meredith RW; Gatesy J; Murphy WJ; Ryder OA; Springer MS

Abstract

Vestigial structures occur at both the anatomical and molecular levels, but studies documenting the co-occurrence of morphological degeneration in the fossil record and molecular decay in the genome are rare. Here, we use morphology, the fossil record, and phylogenetics to predict the occurrence of "molecular fossils" of the enamelin (ENAM) gene in four different orders of placental mammals (Tubulidentata, Pholidota, Cetacea, Xenarthra) with toothless and/or enamelless taxa. Our results support the "molecular fossil" hypothesis and demonstrate the occurrence of frameshift mutations and/or stop codons in all toothless and enamelless taxa. We then use a novel method based on selection intensity estimates for codons (omega) to calculate the timing of iterated enamel loss in the fossil record of aardvarks and pangolins, and further show that the molecular evolutionary history of ENAM predicts the occurrence of enamel in basal representatives of Xenarthra (sloths, anteaters, armadillos) even though frameshift mutations are ubiquitous in ENAM sequences of living xenarthrans. The molecular decay of ENAM parallels the morphological degeneration of enamel in the fossil record of placental mammals and provides manifest evidence for the predictive power of Darwin's theory.

Additional References

Pseudogenization of the tooth gene enamelysin (MMP20) in the common ancestor of extant baleen whales. (2011) (https://pubmed.ncbi.nlm.nih.gov/20861053)

RELATED GEPHE

Related Genes

3 (ameloblastin (AMBN), amelogenin (AMEL), enamelysin (MMP20)) (https://www.gephebase.org/search-criteria?/or+Taxon ID=^9721^/and+Trait=Tooth absence/or+Taxon ID=^27606^/and+Trait=Tooth absence/or+Taxon ID=^9773^/and+Trait=Tooth absence/or+Taxon ID=^9764^/and+Trait=Tooth absence/or+Taxon ID=^27604^/and+Trait=Tooth absence/and+groupHaplotypes=true#gephebase-summary-title)

Related Haplotypes

1 (https://www.gephebase.org/search-criteria?/or+Gene Gephebase=^enamelin (ENAM)^/and+Taxon ID=^9721^/or+Gene Gephebase=^enamelin (ENAM)^/and+Taxon ID=^27606^/or+Gene Gephebase=^enamelin (ENAM)^/and+Taxon ID=^9773^/or+Gene Gephebase=^enamelin (ENAM)^/and+Taxon ID=^9764^/or+Gene Gephebase=^enamelin (ENAM)^/and+Taxon ID=^27604^#gephebase-summary-title)

EXTERNAL LINKS

COMMENTS