

GEPHE SUMMARY

		Gephebase Gene		GepheID
enamelysin (MMP20) ( <a href="https://www.gephebase.org/search-criteria?/and+Gene">https://www.gephebase.org/search-criteria?/and+Gene</a> )			GP00001940	
Gephebase="enamelysin (MMP20)"#gephebase-summary-title)				Main curator
	Entry Status		Courtier	
Published				

PHENOTYPIC CHANGE

		Trait Category
Physiology ( <a href="https://www.gephebase.org/search-criteria?/and+Trait">https://www.gephebase.org/search-criteria?/and+Trait</a> )		
Category="Physiology"#gephebase-summary-title)		Trait
Tooth absence (no enamel production) ( <a (no="" absence="" enamel="" href="https://www.gephebase.org/search-criteria?/and+Trait=" production)"#gephebase-summary-title"="" tooth="">https://www.gephebase.org/search-criteria?/and+Trait="Tooth absence (no enamel production)"#gephebase-summary-title</a> )		
		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 ( <a href="https://www.gephebase.org/search-criteria?/and+Taxonomic">https://www.gephebase.org/search-criteria?/and+Taxonomic</a> )		
Status="Intergeneric or Higher"#gephebase-summary-title)		

Taxon A		Taxon B #1
	Latin Name	
Physeter catodon		Balaenoptera physalus
( <a catodon"#gephebase-summary-title"="" href="https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=" physeter="">https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms="Physeter catodon"#gephebase-summary-title</a> )		( <a balaenoptera="" href="https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=" physalus"#gephebase-summary-title"="">https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms="Balaenoptera physalus"#gephebase-summary-title</a> )
	Common Name	
sperm whale		Fin whale
	Synonyms	
Physeter macrocephalus; sperm whale; Physeter catodon Linnaeus, 1758		Fin whale; common rorqual; finback whale; Balaenoptera physalus (Linnaeus, 1758)
	Rank	
species		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; Odontoceti; Physeteridae; Physeter		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; Balaenoptera
	Parent	
Physeter () - (Rank: genus)		Balaenoptera () - (Rank: genus)
( <a href="https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=9753">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=9753</a> )		( <a href="https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=9766">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=9766</a> )
	NCBI Taxonomy ID	
9755		9770
( <a href="https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=9755">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=9755</a> )		( <a href="https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=9770">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=9770</a> )
	is Taxon A an Intraspecies?	
No		is Taxon B an Intraspecies?
		No

Taxon B #2		Latin Name
		Balaena mysticetus
		( <a balaena="" href="https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=" mysticetus"#gephebase-summary-title"="">https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms="Balaena mysticetus"#gephebase-summary-title</a> )
		Common Name
		bowhead whale
		Synonyms
		bowhead whale; Greenland right whale; bowhead; Balaena mysticetus Linnaeus, 1758; Balaena mysticetus; Balaena mysticeti
		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; Balaena
		Parent
		Balaena () - (Rank: genus)
		( <a href="https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=27601">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=27601</a> )

Taxon B #2		Latin Name
		Balaena mysticetus
		( <a balaena="" href="https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=" mysticetus"#gephebase-summary-title"="">https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms="Balaena mysticetus"#gephebase-summary-title</a> )
		Common Name
		bowhead whale
		Synonyms
		bowhead whale; Greenland right whale; bowhead; Balaena mysticetus Linnaeus, 1758; Balaena mysticetus; Balaena mysticeti
		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; Balaena
		Parent
		Balaena () - (Rank: genus)
		( <a href="https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=27601">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=27601</a> )

27602

(<https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=27602>)

is Taxon B an Infrappecies?

No

Taxon B #3

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 novaeangliae

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 Infrappecies?

No

GENOTYPIC CHANGE

<p>MMP20</p> <p>Al2A2; MMP-20</p> <p>9606.ENSPP00000260228 (<a href="http://string-db.org/newstring.cgi/show_network_section.pl?identifier=9606.ENSPP00000260228">http://string-db.org/newstring.cgi/show_network_section.pl?identifier=9606.ENSPP00000260228</a>)</p> <p>Belongs to the peptidase M10A family.</p> <p>GO - Molecular Function</p> <p>GO:0004222 : metalloendopeptidase activity (<a href="https://www.ebi.ac.uk/QuickGO/term/GO:0004222">https://www.ebi.ac.uk/QuickGO/term/GO:0004222</a>)</p> <p>GO:0008270 : zinc ion binding (<a href="https://www.ebi.ac.uk/QuickGO/term/GO:0008270">https://www.ebi.ac.uk/QuickGO/term/GO:0008270</a>)</p> <p>GO - Biological Process</p> <p>GO:0030198 : extracellular matrix organization (<a href="https://www.ebi.ac.uk/QuickGO/term/GO:0030198">https://www.ebi.ac.uk/QuickGO/term/GO:0030198</a>)</p> <p>GO:0006508 : proteolysis (<a href="https://www.ebi.ac.uk/QuickGO/term/GO:0006508">https://www.ebi.ac.uk/QuickGO/term/GO:0006508</a>)</p> <p>GO:0030163 : protein catabolic process (<a href="https://www.ebi.ac.uk/QuickGO/term/GO:0030163">https://www.ebi.ac.uk/QuickGO/term/GO:0030163</a>)</p> <p>GO:0030574 : collagen catabolic process (<a href="https://www.ebi.ac.uk/QuickGO/term/GO:0030574">https://www.ebi.ac.uk/QuickGO/term/GO:0030574</a>)</p> <p>GO:0022617 : extracellular matrix disassembly (<a href="https://www.ebi.ac.uk/QuickGO/term/GO:0022617">https://www.ebi.ac.uk/QuickGO/term/GO:0022617</a>)</p> <p>GO:0097186 : amelogenesis (<a href="https://www.ebi.ac.uk/QuickGO/term/GO:0097186">https://www.ebi.ac.uk/QuickGO/term/GO:0097186</a>)</p> <p>GO:0070173 : regulation of enamel mineralization (<a href="https://www.ebi.ac.uk/QuickGO/term/GO:0070173">https://www.ebi.ac.uk/QuickGO/term/GO:0070173</a>)</p> <p>GO - Cellular Component</p> <p>GO:0005576 : extracellular region (<a href="https://www.ebi.ac.uk/QuickGO/term/GO:0005576">https://www.ebi.ac.uk/QuickGO/term/GO:0005576</a>)</p> <p>GO:0031012 : extracellular matrix (<a href="https://www.ebi.ac.uk/QuickGO/term/GO:0031012">https://www.ebi.ac.uk/QuickGO/term/GO:0031012</a>)</p> <p>GO:0005615 : extracellular space (<a href="https://www.ebi.ac.uk/QuickGO/term/GO:0005615">https://www.ebi.ac.uk/QuickGO/term/GO:0005615</a>)</p> <p>Yes (<a href="https://www.gephebase.org/search-criteria?/and+Presumptive Null=~Yes^#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+Presumptive Null=~Yes^#gephebase-summary-title</a>)</p> <p>Coding (<a href="https://www.gephebase.org/search-criteria?/and+Molecular Type=~Coding^#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+Molecular Type=~Coding^#gephebase-summary-title</a>)</p> <p>Insertion (<a href="https://www.gephebase.org/search-criteria?/and+Aberration Type=~Insertion^#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+Aberration Type=~Insertion^#gephebase-summary-title</a>)</p> <p>100-999 bp</p>	<p>Generic Gene Name</p> <p>Synonyms</p> <p>String</p> <p>Sequence Similarities</p> <p>GO - Molecular Function</p> <p>GO - Biological Process</p> <p>GO - Cellular Component</p>	<p>O60882 (<a href="http://www.uniprot.org/uniprot/O60882">http://www.uniprot.org/uniprot/O60882</a>)</p> <p>0</p>	<p>UniProtKB Homo sapiens</p> <p>GenebankID or UniProtKB</p> <p>Presumptive Null</p> <p>Molecular Type</p> <p>Aberration Type</p> <p>Insertion Size</p>
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insertion of a CHR-2 SINE retroposon in exon 2 of MMP20 which would result in premature truncation of the MMP20 protein owing to stop codons in all possible reading frames of the CHR-2 SINE. The length of the MMP20 SINE ranges from 302 bp (*B. musculus*) to 318 bp (*B. physalus*). This mutation is found in eight investigated species of baleen whales. Other inactivating mutations (nonsense and frameshift mutations) are found in various species

Experimental Evidence

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

Main Reference

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

Authors

Meredith RW; Gatesy J; Cheng J; Springer MS

Abstract

Whales in the suborder Mysticeti are filter feeders that use baleen to sift zooplankton and small fish from ocean waters. Adult mysticetes lack teeth, although tooth buds are present in foetal stages. Cladistic analyses suggest that functional teeth were lost in the common ancestor of crown-group Mysticeti. DNA sequences for the tooth-specific genes, ameloblastin (AMBN), enamelin (ENAM) and amelogenin (AMEL), have frameshift mutations and/or stop codons in this taxon, but none of these molecular cavities are shared by all extant mysticetes. Here, we provide the first evidence for pseudogenization of a tooth gene, enamelysin (MMP20), in the common ancestor of living baleen whales. Specifically, pseudogenization resulted from the insertion of a CHR-2 SINE retroposon in exon 2 of MMP20. Genomic and palaeontological data now provide congruent support for the loss of enamel-capped teeth on the common ancestral branch of crown-group mysticetes. The new data for MMP20 also document a polymorphic stop codon in exon 2 of the pygmy sperm whale (*Kogia breviceps*), which has enamel-less teeth. These results, in conjunction with the evidence for pseudogenization of MMP20 in Hoffmann's two-toed sloth (*Choloepus hoffmanni*), another enamel-less species, support the hypothesis that the only unique, non-overlapping function of the MMP20 gene is in enamel formation.

Additional References

## RELATED GEPHE

No matches found.

Related Genes

No matches found.

Related Haplotypes

## EXTERNAL LINKS

## COMMENTS

@TE @ParallelEvolution in Kogia whales. Cladistic analyses suggest that functional teeth were lost in the common ancestor of crown-group Mysticeti.