GEPHE SUMMARY

Gephebase Gene
opsin - rhodopsin1 (RH1) (https://www.gephebase.org/search-criteria?/and+Gene Gephebase=^opsin - rhodopsin1 (RH1)^#gephebase-summary-title)

GepheID
GP00000789

Entry Status
Published

Main curator
Martin

PHENOTYPIC CHANGE

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

Trait
Color vision (blue-shift) (https://www.gephebase.org/search-criteria?/and+Trait=^Color vision (blue-shift)^#gephebase-summary-title)

Trait State in Taxon A
Other cetaceans

Trait State in Taxon B
Deep-diving physeteroids (giant sperm whale; pygmy sperm whale)

Ancestral State
Data not curated

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

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

Common Name
sperm whales

Synonyms
sperm whales

Rank
family

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

Parent
Odontoceti (tooth whales) - (Rank: suborder) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 9722)

NCBI Taxonomy ID
9750 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 9750)

is Taxon B an Infraspecies?
No

GENOTYPIC CHANGE

Generic Gene Name
RHO

Synonyms
RP4; OPN2; CSNBAD1

String
9606.ENSP00000296271 (http://string-db.org/newstring_cgi/show_network_section.pl?identifier=9606.ENSP00000296271)

Sequence Similarities
Belongs to the G-protein coupled receptor 1 family. Opsin subfamily.

GO - Molecular Function
GO:0046872 : metal ion binding (https://www.ebi.ac.uk/QuickGO/term/GO:0046872)
GO:0004930 : G protein-coupled receptor activity (https://www.ebi.ac.uk/QuickGO/term/GO:0004930)
GO:0008020 : G protein-coupled photoreceptor activity (https://www.ebi.ac.uk/QuickGO/term/GO:0008020)
GO:0005502 : 11-cis retinal binding (https://www.ebi.ac.uk/QuickGO/term/GO:0005502)

GO - Biological Process

UniProtKB Homo sapiens
P08100 (http://www.uniprot.org/uniprot/P08100)

GenebankID or UniProtKB
()

GO:0007186 : G protein-coupled receptor signaling pathway
(https://www.ebi.ac.uk/QuickGO/term/GO:0007186)
GO:0001523 : retinoid metabolic process
(https://www.ebi.ac.uk/QuickGO/term/GO:0001523)
GO:0006468 : protein phosphorylation
(https://www.ebi.ac.uk/QuickGO/term/GO:0006468)
GO:0018298 : protein-chromophore linkage
(https://www.ebi.ac.uk/QuickGO/term/GO:0018298)
GO:0007601 : visual perception (https://www.ebi.ac.uk/QuickGO/term/GO:0007601)
GO:0071482 : cellular response to light stimulus
(https://www.ebi.ac.uk/QuickGO/term/GO:0071482)
GO:0007602 : phototransduction (https://www.ebi.ac.uk/QuickGO/term/GO:0007602)
GO:0016038 : absorption of visible light
(https://www.ebi.ac.uk/QuickGO/term/GO:0016038)
GO:0045494 : photoreceptor cell maintenance
(https://www.ebi.ac.uk/QuickGO/term/GO:0045494)
GO:0007603 : phototransduction, visible light
(https://www.ebi.ac.uk/QuickGO/term/GO:0007603)
GO:0022400 : regulation of rhodopsin mediated signaling pathway
(https://www.ebi.ac.uk/QuickGO/term/GO:0022400)
GO:0060041 : retina development in camera-type eye
(https://www.ebi.ac.uk/QuickGO/term/GO:0060041)
GO:0016056 : rhodopsin mediated signaling pathway
(https://www.ebi.ac.uk/QuickGO/term/GO:0016056)

GO - Cellular Component

GO:0016021 : integral component of membrane
(https://www.ebi.ac.uk/QuickGO/term/GO:0016021)
GO:0005886 : plasma membrane (https://www.ebi.ac.uk/QuickGO/term/GO:0005886)
GO:0000139 : Golgi membrane (https://www.ebi.ac.uk/QuickGO/term/GO:0000139)
GO:0005887 : integral component of plasma membrane
(https://www.ebi.ac.uk/QuickGO/term/GO:0005887)
GO:0005794 : Golgi apparatus (https://www.ebi.ac.uk/QuickGO/term/GO:0005794)
GO:0005911 : cell-cell junction (https://www.ebi.ac.uk/QuickGO/term/GO:0005911)
GO:0001750 : photoreceptor outer segment
(https://www.ebi.ac.uk/QuickGO/term/GO:0001750)
GO:0097381 : photoreceptor disc membrane
(https://www.ebi.ac.uk/QuickGO/term/GO:0097381)
GO:0060170 : ciliary membrane (https://www.ebi.ac.uk/QuickGO/term/GO:0060170)
GO:0030660 : Golgi-associated vesicle membrane
(https://www.ebi.ac.uk/QuickGO/term/GO:0030660)
GO:0001917 : photoreceptor inner segment
(https://www.ebi.ac.uk/QuickGO/term/GO:0001917)
GO:0060342 : photoreceptor inner segment membrane
(https://www.ebi.ac.uk/QuickGO/term/GO:0060342)
GO:0042622 : photoreceptor outer segment membrane
(https://www.ebi.ac.uk/QuickGO/term/GO:0042622)

Presumptive Null

No (https://www.gephebase.org/search-criteria?/and+Presumptive Null=^No^#gephebase-summary-title)

Molecular Type

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

Aberration Type

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

SNP Coding Change

Nonsynonymous

Molecular Details of the Mutation

K195T

Experimental Evidence

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

	Taxon A	Taxon B	Position
Codon	-	-	-
Amino-acid	-	-	-

Main Reference

Rod monochromacy and the coevolution of cetacean retinal opsins. (2013) (https://pubmed.ncbi.nlm.nih.gov/23637615)

Authors

Meredith RW; Gatesy J; Emerling CA; York VM; Springer MS

Abstract

Cetaceans have a long history of commitment to a fully aquatic lifestyle that extends back to the Eocene. Extant species have evolved a spectacular array of adaptations in conjunction with their deployment into a diverse array of aquatic habitats. Sensory systems are among those that have experienced radical transformations in the evolutionary history of this clade. In the case of vision, previous studies have demonstrated important changes in the genes encoding rod opsin (RH1), short-wavelength sensitive opsin 1 (SWS1), and long-wavelength sensitive opsin (LWS) in selected cetaceans, but have not examined the full complement of opsin genes across the complete range of cetacean families. Here, we report protein-coding sequences for RH1 and both color opsin genes (SWS1, LWS) from representatives of all extant cetacean families. We examine competing hypotheses pertaining to the timing of blue shifts in RH1 relative to SWS1 inactivation in the early history of Cetacea, and we test the hypothesis that some cetaceans are rod monochomats. Molecular evolutionary analyses contradict the "coastal" hypothesis, wherein SWS1 was pseudogenized in the common ancestor of Cetacea, and instead suggest that RH1 was blue-shifted in the common ancestor of Cetacea before SWS1 was independently knocked

out in baleen whales (Mysticeti) and in toothed whales (Odontoceti). Further, molecular evidence implies that LWS was inactivated convergently on at least five occasions in Cetacea: (1) Balaenidae (bowhead and right whales), (2) Balaenopteroidea (rorquals plus gray whale), (3) Mesoplodon bidens (Sowerby's beaked whale), (4) Physeter macrocephalus (giant sperm whale), and (5) Kogia breviceps (pygmy sperm whale). All of these cetaceans are known to dive to depths of at least 100 m where the underwater light field is dim and dominated by blue light. The knockout of both SWS1 and LWS in multiple cetacean lineages renders these taxa rod monochromats, a condition previously unknown among mammalian species.

Additional References

RELATED GEPHE

Related Genes

2 (opsin - (SWS1), opsin - rhodopsin (LWS)) (https://www.gephebase.org/search-criteria?/or+Taxon ID=^9721^/and+Trait=Color vision/or+Taxon ID=^9750^/and+Trait=Color vision/and+groupHaplotypes=true#gephebase-summary-title)

Related Haplotypes

3 (https://www.gephebase.org/search-criteria?/or+Gene Gephebase=^opsin - rhodopsin1 (RH1)^/and+Taxon ID=^9721^/or+Gene Gephebase=^opsin - rhodopsin1 (RH1)^/and+Taxon ID=^9750^#gephebase-summary-title)

EXTERNAL LINKS

COMMENTS