

GEPHE SUMMARY

Gephebase Gene
 opsin - (SWS1) ([https://www.gephebase.org/search-criteria?/and+Gene+Gephebase=^opsin-\(SWS1\)^#gephebase-summary-title](https://www.gephebase.org/search-criteria?/and+Gene+Gephebase=^opsin-(SWS1)^#gephebase-summary-title))
 GP00000757
 Entry Status
 Martin
 Published
 GepheID
 Main curator

PHENOTYPIC CHANGE

Trait Category
 Physiology (<https://www.gephebase.org/search-criteria?/and+Trait+Category=^Physiology^#gephebase-summary-title>)
 Trait
 Color vision (<https://www.gephebase.org/search-criteria?/and+Trait=^Color+vision^#gephebase-summary-title>)
 Trait State in Taxon A
 Other cetaceans
 Trait State in Taxon B
 Odontocetes
 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	Taxon B	Latin Name
Cetacea (https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=^Cetacea^#gephebase-summary-title)	Odontoceti (https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=^Odontoceti^#gephebase-summary-title)		
Common Name	Common Name	Common Name	Common Name
whales	tooth whales		
Synonyms	Synonyms	Synonyms	Synonyms
whales; cetaceans; whale; whales, dolphins, and porpoises	tooth whales		
Rank	Rank	Rank	Rank
order	suborder		
Lineage	Lineage	Lineage	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	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		
Parent	Parent	Parent	Parent
Cetartiodactyla (whales, hippos, ruminants, pigs, camels etc.) - (Rank: no rank) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=91561)	Cetacea (whales) - (Rank: order) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=9721)		
NCBI Taxonomy ID	NCBI Taxonomy ID	NCBI Taxonomy ID	NCBI Taxonomy ID
9721 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=9721)	9722 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=9722)		
is Taxon A an Intraspecies?	is Taxon B an Intraspecies?	is Taxon B an Intraspecies?	is Taxon B an Intraspecies?
No	No		

GENOTYPIC CHANGE

Generic Gene Name
 OPN1SW
 P03999 (<http://www.uniprot.org/uniprot/P03999>)
 UniProtKB Homo sapiens
 Synonyms
 BCP; BOP; CBT
 0
 GenebankID or UniProtKB
 String
 9606.ENSP00000249389
 (http://string-db.org/newstring.cgi/show_network_section.pl?identifier=9606.ENSP00000249389)
 Sequence Similarities
 Belongs to the G-protein coupled receptor 1 family. Opsin subfamily.
 GO - Molecular Function
 GO:0038023 : signaling receptor activity
 (<https://www.ebi.ac.uk/QuickGO/term/GO:0038023>)
 GO:0008020 : G protein-coupled photoreceptor activity
 (<https://www.ebi.ac.uk/QuickGO/term/GO:0008020>)
 GO - Biological Process
 GO:0007165 : signal transduction (<https://www.ebi.ac.uk/QuickGO/term/GO:0007165>)
 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: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 - Cellular Component

GO:0005887 : integral component of plasma membrane
 (<https://www.ebi.ac.uk/QuickGO/term/GO:0005887>)
 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>)

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

E113G; disrupts opsin-chromophore binding

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

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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 monochromats. 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 - rhodopsin (LWS), opsin - rhodopsin1 (RH1)) (<https://www.gephebase.org/search-criteria?/or+Taxon ID=^9721^/and+Trait=Color vision/or+Taxon ID=^9722^/and+Trait=Color vision/and+groupHaplotypes=true#gephebase-summary-title>)

Related Haplotypes

1 ([https://www.gephebase.org/search-criteria?/or+Gene Gephebase=^opsin - \(SWS1\)^/and+Taxon ID=^9721^/or+Gene Gephebase=^opsin - \(SWS1\)^/and+Taxon ID=^9722^#gephebase-summary-title](https://www.gephebase.org/search-criteria?/or+Gene Gephebase=^opsin - (SWS1)^/and+Taxon ID=^9721^/or+Gene Gephebase=^opsin - (SWS1)^/and+Taxon ID=^9722^#gephebase-summary-title))

EXTERNAL LINKS

COMMENTS

