

## GEPHE SUMMARY

		Gephebase Gene		GepheID
opsin - rhodopsin (LWS) ( <a href="https://www.gephebase.org/search-criteria?/and+Gene">https://www.gephebase.org/search-criteria?/and+Gene</a> )			GP00000774	
Gephebase="opsin - rhodopsin (LWS)"#gephebase-summary-title)				Main curator
		Entry Status	Martin	
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		
Color vision ( <a color"="" href="https://www.gephebase.org/search-criteria?/and+Trait=">https://www.gephebase.org/search-criteria?/and+Trait="Color</a> )				
vision"#gephebase-summary-title)		Trait State in Taxon A		
Other cetaceans				
		Trait State in Taxon B		
Mesoplodon bidens				
		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		
	Latin Name		Latin Name	
Cetacea		Mesoplodon bidens		
( <a href="https://www.gephebase.org/search-criteria?/and+Taxon">https://www.gephebase.org/search-criteria?/and+Taxon</a> and		( <a href="https://www.gephebase.org/search-criteria?/and+Taxon">https://www.gephebase.org/search-criteria?/and+Taxon</a> and Synonyms="Mesoplodon		
Synonyms="Cetacea"#gephebase-summary-title)		bidens"#gephebase-summary-title)		
	Common Name		Common Name	
whales		Sowerby's beaked whale		
	Synonyms		Synonyms	
whales; cetaceans; whale; whales, dolphins, and porpoises		Sowerby's beaked whale		
	Rank		Rank	
order		species		
	Lineage		Lineage	
cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Deuterostomia;		cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Deuterostomia;		
Chordata; Craniata; Vertebrata; Gnathostomata; Teleostomi; Euteleostomi; Sarcopterygii;		Chordata; Craniata; Vertebrata; Gnathostomata; Teleostomi; Euteleostomi; Sarcopterygii;		
Dipnotetrapodomorpha; Tetrapoda; Amniota; Mammalia; Theria; Eutheria; Boreoeutheria;		Dipnotetrapodomorpha; Tetrapoda; Amniota; Mammalia; Theria; Eutheria; Boreoeutheria;		
Laurasiatheria; Cetartiodactyla		Laurasiatheria; Cetartiodactyla; Cetacea; Odontoceti; Ziphiidae; Mesoplodon		
	Parent		Parent	
Cetartiodactyla (whales, hippos, ruminants, pigs, camels etc.) - (Rank: no rank)		Mesoplodon () - (Rank: genus)		
( <a href="https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=91561">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=91561</a> )		( <a href="https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=9757">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=9757</a> )		
	NCBI Taxonomy ID		NCBI Taxonomy ID	
9721		48745		
( <a href="https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=9721">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=9721</a> )		( <a href="https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=48745">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=48745</a> )		
	is Taxon A an Intraspecies?		is Taxon B an Intraspecies?	
No		No		

## GENOTYPIC CHANGE

		Generic Gene Name		UniProtKB Homo sapiens
OPN1LW			P04000 ( <a href="http://www.uniprot.org/uniprot/P04000">http://www.uniprot.org/uniprot/P04000</a> )	
		Synonyms		GenebankID or UniProtKB
RCP			AAC12763 ( <a href="https://www.ncbi.nlm.nih.gov/nuccore/AAC12763">https://www.ncbi.nlm.nih.gov/nuccore/AAC12763</a> )	
		String		
9606.ENSP00000358967				
( <a href="http://string-db.org/newstring.cgi/show_network_section.pl?identifier=9606.ENSP00000358967">http://string-db.org/newstring.cgi/show_network_section.pl?identifier=9606.ENSP00000358967</a> )				
		Sequence Similarities		
Belongs to the G-protein coupled receptor 1 family. Opsin subfamily.				
		GO - Molecular Function		
GO:0008020 : G protein-coupled photoreceptor activity				
( <a href="https://www.ebi.ac.uk/QuickGO/term/GO:0008020">https://www.ebi.ac.uk/QuickGO/term/GO:0008020</a> )				
GO:0009881 : photoreceptor activity ( <a href="https://www.ebi.ac.uk/QuickGO/term/GO:0009881">https://www.ebi.ac.uk/QuickGO/term/GO:0009881</a> )				
		GO - Biological Process		
GO:0007165 : signal transduction ( <a href="https://www.ebi.ac.uk/QuickGO/term/GO:0007165">https://www.ebi.ac.uk/QuickGO/term/GO:0007165</a> )				
GO:0007186 : G protein-coupled receptor signaling pathway				
( <a href="https://www.ebi.ac.uk/QuickGO/term/GO:0007186">https://www.ebi.ac.uk/QuickGO/term/GO:0007186</a> )				

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:0032467 : positive regulation of cytokinesis  
 (https://www.ebi.ac.uk/QuickGO/term/GO:0032467)

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

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

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

Insertion Size

1-9 bp

Molecular Details of the Mutation

4bp frameshift insertion in exon 2 of LWS

Experimental Evidence

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

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 - (SWS1), opsin - rhodopsin1 (RH1)) (https://www.gephebase.org/search-criteria?/or+Taxon ID=^9721^/and+Trait=Color vision/or+Taxon ID=^48745^/and+Trait=Color vision/and+groupHaplotypes=true#gephebase-summary-title)

Related Haplotypes

5 (https://www.gephebase.org/search-criteria?/or+Gene Gephebase=^opsin - rhodopsin (LWS)^/and+Taxon ID=^9721^/or+Gene Gephebase=^opsin - rhodopsin (LWS)^/and+Taxon ID=^48745^#gephebase-summary-title)

EXTERNAL LINKS

COMMENTS

