

GEPHE SUMMARY

opsin - rhodopsin (LWS) (https://www.gephebase.org/search-criteria?/and+Gene)		Gephebase Gene	GP00000772	GepheID
Gephebase="opsin - rhodopsin (LWS)"#gephebase-summary-title)				Main curator
Published		Entry Status	Martin	

PHENOTYPIC CHANGE

Physiology (https://www.gephebase.org/search-criteria?/and+Trait)		Trait Category		
Category="Physiology"#gephebase-summary-title)				
Color vision (<a color"="" href="https://www.gephebase.org/search-criteria?/and+Trait=">https://www.gephebase.org/search-criteria?/and+Trait="Color)		Trait		
vision"#gephebase-summary-title)				
Other cetaceans		Trait State in Taxon A		
Kogia breviceps		Trait State in Taxon B		
Taxon A		Ancestral State		
Intergenic or Higher (https://www.gephebase.org/search-criteria?/and+Taxonomic)		Taxonomic Status		
Status="Intergenic or Higher"#gephebase-summary-title)				

Taxon A		Taxon B	
	Latin Name		Latin Name
Cetacea		Kogia breviceps	
(https://www.gephebase.org/search-criteria?/and+Taxon)		(https://www.gephebase.org/search-criteria?/and+Taxon)	
Synonyms="Cetacea"#gephebase-summary-title)		Synonyms="Kogia	
	Common Name	breviceps"#gephebase-summary-title)	Common Name
whales		pygmy sperm whale	
	Synonyms		Synonyms
whales; cetaceans; whale; whales, dolphins, and porpoises		pygmy sperm whale	
	Rank	species	Rank
order			
	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; Physeteridae; Kogia	
	Parent		Parent
Cetartiodactyla (whales, hippos, ruminants, pigs, camels etc.) - (Rank: no rank)		Kogia () - (Rank: genus)	
(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=91561)		(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=9751)	
	NCBI Taxonomy ID		NCBI Taxonomy ID
9721		27615	
(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=9721)		(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=27615)	
	is Taxon A an Intraspecies?		is Taxon B an Intraspecies?
No		No	

GENOTYPIC CHANGE

OPN1LW	Generic Gene Name	P04000 (http://www.uniprot.org/uniprot/P04000)	UniProtKB Homo sapiens
RCP	Synonyms	()	GenebankID or UniProtKB
	String		
9606.ENSP00000358967			
(http://string-db.org/newstring.cgi/show_network_section.pl?identifier=9606.ENSP00000358967)			
	Sequence Similarities		
Belongs to the G-protein coupled receptor 1 family. Opsin subfamily.			
	GO - Molecular Function		
GO:0008020 : G protein-coupled photoreceptor activity			
(https://www.ebi.ac.uk/QuickGO/term/GO:0008020)			
GO:0009881 : photoreceptor activity (https://www.ebi.ac.uk/QuickGO/term/GO:0009881)			
	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: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

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

Deletion Size

10-99 bp

Molecular Details of the Mutation

44bp frameshift deletion 9 + possibly GT to CT splice site mutation

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=^27615^/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=^27615^#gephebase-summary-title)

EXTERNAL LINKS

COMMENTS

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