

GEPHE SUMMARY

Gephebase Gene
opsin - rhodopsin (LWS)

Entry Status
Published

GepheID
GP00000774

Main curator
Martin

PHENOTYPIC CHANGE

Trait Category
Physiology

Trait
Color vision

Trait State in Taxon A
Other cetaceans

Trait State in Taxon B
Mesoplodon bidens

Ancestral State
Taxon A

Taxonomic Status
Intergeneric or Higher

Taxon A

Latin Name
Cetacea

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)

NCBI Taxonomy ID
9721

is Taxon A an Intraspecies?
No

Taxon B

Latin Name
Mesoplodon bidens

Common Name
Sowerby's beaked whale

Synonyms
Sowerby's beaked whale

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; Odontoceti; Ziphiidae; Mesoplodon

Parent
Mesoplodon () - (Rank: genus)

NCBI Taxonomy ID
48745

is Taxon B an Intraspecies?
No

GENOTYPIC CHANGE

Generic Gene Name
OPN1LW

Synonyms
RCP

String
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
GO:0009881 : photoreceptor activity

GO - Biological Process
GO:0007165 : signal transduction
GO:0007186 : G protein-coupled receptor signaling pathway
GO:0001523 : retinoid metabolic process
GO:0018298 : protein-chromophore linkage
GO:0007601 : visual perception
GO:0071482 : cellular response to light stimulus
GO:0007602 : phototransduction

UniProtKB Homo sapiens
P04000

GenebankID or UniProtKB
AAC12763

GO:0032467 : positive regulation of cytokinesis

GO - Cellular Component

GO:0005887 : integral component of plasma membrane

GO:0001750 : photoreceptor outer segment

GO:0097381 : photoreceptor disc membrane

Presumptive Null

Yes

Molecular Type

Coding

Aberration Type

Insertion

Insertion Size

1-9 bp

Molecular Details of the Mutation

4bp frameshift insertion in exon 2 of LWS

Experimental Evidence

Candidate Gene

Main Reference

Rod monochromacy and the coevolution of cetacean retinal opsins. (2013)

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 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))

Related Haplotypes

5

COMMENTS