

GEPHE SUMMARY

opsin - (SWS2) (https://www.gephebase.org/search-criteria?/and+Gene+Gephebase=^opsin-(SWS2)^#gephebase-summary-title)		Gephebase Gene	GP00001679	GepheID
Published	Entry Status	Prigent		Main curator

PHENOTYPIC CHANGE

Physiology (https://www.gephebase.org/search-criteria?/and+Trait+Category=^Physiology^#gephebase-summary-title)		Trait Category		
Color vision (blue- and red-shifts) (https://www.gephebase.org/search-criteria?/and+Trait=^Color+vision+(blue-+and+red-shifts)^#gephebase-summary-title)		Trait		
Photoreception adapted to clearwater lakes		Trait State in Taxon A		
Photoreception adapted to blackwater lakes		Trait State in Taxon B		
Unknown		Ancestral State		
Intraspecific (https://www.gephebase.org/search-criteria?/and+Taxonomic+Status=^Intraspecific^#gephebase-summary-title)		Taxonomic Status		
		Taxon A		Taxon B
Gasterosteus aculeatus (https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=^Gasterosteus+aculeatus^#gephebase-summary-title)		Latin Name	Gasterosteus aculeatus (https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=^Gasterosteus+aculeatus^#gephebase-summary-title)	Latin Name
three-spined stickleback		Common Name	three-spined stickleback	Common Name
three-spined stickleback; three spined stickleback; Gasterosteus aculeatus Linnaeus, 1758		Synonyms	three-spined stickleback; three spined stickleback; Gasterosteus aculeatus Linnaeus, 1758	Synonyms
species		Rank	species	Rank
cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Deuterostomia; Chordata; Craniata; Vertebrata; Gnathostomata; Teleostomi; Euteleostomi; Actinopterygii; Actinopteri; Neopterygii; Teleostei; Osteoglossocephalai; Clupeocephala; Euteleosteorpha; Neoteleostei; Eurypterygia; Ctenosquamata; Acanthomorpha; Euacanthomorpha; Percormorphacea; Eupercaria; Perciformes; Cottioidei; Gasterosteales; Gasterosteidae; Gasterosteus		Lineage	cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Deuterostomia; Chordata; Craniata; Vertebrata; Gnathostomata; Teleostomi; Euteleostomi; Actinopterygii; Actinopteri; Neopterygii; Teleostei; Osteoglossocephalai; Clupeocephala; Euteleosteorpha; Neoteleostei; Eurypterygia; Ctenosquamata; Acanthomorpha; Euacanthomorpha; Percormorphacea; Eupercaria; Perciformes; Cottioidei; Gasterosteales; Gasterosteidae; Gasterosteus	Lineage
Gasterosteus () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=69292)		Parent	Gasterosteus () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=69292)	Parent
69293 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=69293)		NCBI Taxonomy ID	69293 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=69293)	NCBI Taxonomy ID
Yes		is Taxon A an Intraspecies?	Yes	is Taxon B an Intraspecies?
threespine stickleback from clearwater or from blackwater lake transplanted in clearwater pond (resampled after 19 years)		Taxon A Description	threespine sticklebacks from blackwater lakes	Taxon B Description

GENOTYPIC CHANGE

opn1sw2	Generic Gene Name	Q9W6A8 (http://www.uniprot.org/uniprot/Q9W6A8)	UniProtKB Danio rerio
SWS2; bluops; zblue; Sl:zK13A21.5; opn1sw1; sws2	Synonyms		GenebankID or UniProtKB
7955.ENSDDARP00000019477 (http://string-db.org/newstring.cgi/show_network_section.pl?identifier=7955.ENSDDARP00000019477)	String	0	
Belongs to the G-protein coupled receptor 1 family. Opsin subfamily.	Sequence Similarities		
GO:0009882 : blue light photoreceptor activity (https://www.ebi.ac.uk/QuickGO/term/GO:0009882)	GO - Molecular Function		

GO:0008020 : G protein-coupled photoreceptor activity
(<https://www.ebi.ac.uk/QuickGO/term/GO:0008020>)

GO - Biological Process

GO:0007186 : G protein-coupled receptor signaling pathway
(<https://www.ebi.ac.uk/QuickGO/term/GO:0007186>)

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>)

Mutation #1

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

Presumptive Null

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

Molecular Type

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

Aberration Type

Nonsynonymous

SNP Coding Change

7 aa changes including 2 changes (C97S & G109A) known to cause a red-shift in light absorption favored in blackwater lakes but disfavored in the clearwater habitat

Molecular Details of the Mutation

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

Experimental Evidence

	Taxon A	Taxon B	Position
Codon	-	-	-
Amino-acid	Cys	Ser	97

Convergent evolution of SWS2 opsin facilitates adaptive radiation of threespine stickleback into different light environments. (2017) (<https://pubmed.ncbi.nlm.nih.gov/28399148>)

Main Reference

Marques DA; Taylor JS; Jones FC; Di Palma F; Kingsley DM; Reimchen TE

Authors

Repeated adaptation to a new environment often leads to convergent phenotypic changes whose underlying genetic mechanisms are rarely known. Here, we study adaptation of color vision in threespine stickleback during the repeated postglacial colonization of clearwater and blackwater lakes in the Haida Gwaii archipelago. We use whole genomes from 16 clearwater and 12 blackwater populations, and a selection experiment, in which stickleback were transplanted from a blackwater lake into an uninhabited clearwater pond and resampled after 19 y to test for selection on cone opsin genes. Patterns of haplotype homozygosity, genetic diversity, site frequency spectra, and allele-frequency change support a selective sweep centered on the adjacent blue- and red-light sensitive opsins SWS2 and LWS. The haplotype under selection carries seven amino acid changes in SWS2, including two changes known to cause a red-shift in light absorption, and is favored in blackwater lakes but disfavored in the clearwater habitat of the transplant population. Remarkably, the same red-shifting amino acid changes occurred after the duplication of SWS2 198 million years ago, in the ancestor of most spiny-rayed fish. Two distantly related fish species, bluefin killifish and black bream, express these old paralogs divergently in black- and clearwater habitats, while sticklebacks lost one paralog. Our study thus shows that convergent adaptation to the same environment can involve the same genetic changes on very different evolutionary time scales by reevolving lost mutations and reusing them repeatedly from standing genetic variation.

Abstract

Additional References

Mutation #2

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

Presumptive Null

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

Molecular Type

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

Aberration Type

Nonsynonymous

SNP Coding Change

7 aa changes including 2 changes (C97S & G109A) known to cause a red-shift in light absorption favored in blackwater lakes but disfavored in the clearwater habitat

Molecular Details of the Mutation

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

Experimental Evidence

	Taxon A	Taxon B	Position
Codon	-	-	-
Amino-acid	Gly	Ala	109

Convergent evolution of SWS2 opsin facilitates adaptive radiation of threespine stickleback into different light environments. (2017) (<https://pubmed.ncbi.nlm.nih.gov/28399148>)

Authors

Marques DA; Taylor JS; Jones FC; Di Palma F; Kingsley DM; Reimchen TE

Abstract

Repeated adaptation to a new environment often leads to convergent phenotypic changes whose underlying genetic mechanisms are rarely known. Here, we study adaptation of color vision in threespine stickleback during the repeated postglacial colonization of clearwater and blackwater lakes in the Haida Gwaii archipelago. We use whole genomes from 16 clearwater and 12 blackwater populations, and a selection experiment, in which stickleback were transplanted from a blackwater lake into an uninhabited clearwater pond and resampled after 19 y to test for selection on cone opsin genes. Patterns of haplotype homozygosity, genetic diversity, site frequency spectra, and allele-frequency change support a selective sweep centered on the adjacent blue- and red-light sensitive opsins SWS2 and LWS. The haplotype under selection carries seven amino acid changes in SWS2, including two changes known to cause a red-shift in light absorption, and is favored in blackwater lakes but disfavored in the clearwater habitat of the transplant population. Remarkably, the same red-shifting amino acid changes occurred after the duplication of SWS2 198 million years ago, in the ancestor of most spiny-rayed fish. Two distantly related fish species, bluefin killifish and black bream, express these old paralogs divergently in black- and clearwater habitats, while sticklebacks lost one paralog. Our study thus shows that convergent adaptation to the same environment can involve the same genetic changes on very different evolutionary time scales by reevolving lost mutations and reusing them repeatedly from standing genetic variation.

Additional References

RELATED GEPHE

No matches found.

Related Genes

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Related Haplotypes

EXTERNAL LINKS

COMMENTS

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