

# GEPHE SUMMARY

opsin - rhodopsin (LWRh) ( <a href="https://www.gephebase.org/search-criteria?/and+Gene">https://www.gephebase.org/search-criteria?/and+Gene</a> Gephebase=^opsin - rhodopsin (LWRh)^#gephebase-summary-title)	Gephebase Gene GP00000769	GephelD Main curator
Published	Entry Status Martin	

## 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 (blue shift) ( <a href="https://www.gephebase.org/search-criteria?/and+Trait=^Color">https://www.gephebase.org/search-criteria?/and+Trait=^Color</a> vision (blue shift)^#gephebase-summary-title)	Trait State in Taxon A	
Limenitis astyanax; other butterflies	Trait State in Taxon B	
Limenitis weidemeyerii; L. archippus; L. lorquini	Ancestral State	
Data not curated	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
Limenitis arthemis ( <a href="https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=^Limenitis">https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=^Limenitis</a> arthemis^#gephebase-summary-title)	Latin Name	Latin Name
white admiral	Common Name	Common Name
Basilarchia arthemis; white admiral; Basilarchia arthemis (Drury, 1773)	Synonyms	Synonyms
species	Rank	Rank
cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Protostomia; Ecdysozoa; Panarthropoda; Arthropoda; Mandibulata; Pancrustacea; Hexapoda; Insecta; Dicondylia; Pterygota; Neoptera; Holometabola; Amphiesmenoptera; Lepidoptera; Glossata; Neolepidoptera; Heteroneura; Ditrysia; Obtectomera; Papilionoidea; Nymphalidae; Limenitidinae; Limenitidini; Limenitis	Lineage	Lineage
Limenitis (admirals) - (Rank: genus) ( <a href="https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 124410">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 124410</a> )	Parent	Parent
124411 ( <a href="https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 124411">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 124411</a> )	NCBI Taxonomy ID	NCBI Taxonomy ID
No	is Taxon A an Infraspecies?	is Taxon B an Infraspecies?

## GENOTYPIC CHANGE

LWRh	Generic Gene Name E2DZP1 ( <a href="http://www.uniprot.org/uniprot/E2DZP1">http://www.uniprot.org/uniprot/E2DZP1</a> )	UniProtKB Heliconius melpomene
-	Synonyms AF385332 ( <a href="https://www.ncbi.nlm.nih.gov/nuccore/AF385332">https://www.ncbi.nlm.nih.gov/nuccore/AF385332</a> )	GenebankID or UniProtKB
-	String	
	Sequence Similarities	
Belongs to the G-protein coupled receptor 1 family. Opsin subfamily.	GO - Molecular Function GO:0004930 : G protein-coupled receptor activity ( <a href="https://www.ebi.ac.uk/QuickGO/term/GO:0004930">https://www.ebi.ac.uk/QuickGO/term/GO:0004930</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:0018298 : protein-chromophore linkage ( <a href="https://www.ebi.ac.uk/QuickGO/term/GO:0018298">https://www.ebi.ac.uk/QuickGO/term/GO:0018298</a> )	
	GO:0007601 : visual perception ( <a href="https://www.ebi.ac.uk/QuickGO/term/GO:0007601">https://www.ebi.ac.uk/QuickGO/term/GO:0007601</a> )	
	GO:0007602 : phototransduction ( <a href="https://www.ebi.ac.uk/QuickGO/term/GO:0007602">https://www.ebi.ac.uk/QuickGO/term/GO:0007602</a> )	

GO:0016021 : integral component of membrane

(<https://www.ebi.ac.uk/QuickGO/term/GO:0016021>)

## Mutation #1

No ( <a href="https://www.gepheebase.org/search-criteria/?and+Presumptive+Null=%No%#gepheebase-summary-title">https://www.gepheebase.org/search-criteria/?and+Presumptive+Null=%No%#gepheebase-summary-title</a> )	Presumptive Null
Coding ( <a href="https://www.gepheebase.org/search-criteria/?and+Molecular+Type=%Coding%#gepheebase-summary-title">https://www.gepheebase.org/search-criteria/?and+Molecular+Type=%Coding%#gepheebase-summary-title</a> )	Molecular Type
SNP ( <a href="https://www.gepheebase.org/search-criteria/?and+Aberration+Type=%SNP%#gepheebase-summary-title">https://www.gepheebase.org/search-criteria/?and+Aberration+Type=%SNP%#gepheebase-summary-title</a> )	Aberration Type
Nonsynonymous	SNP Coding Change
I17M; S137A=S180A in human LWS/MWS numbering system	Molecular Details of the Mutation
Candidate Gene ( <a href="https://www.gepheebase.org/search-criteria/?and+Experimental+Evidence=%Candidate+Gene%#gepheebase-summary-title">https://www.gepheebase.org/search-criteria/?and+Experimental+Evidence=%Candidate+Gene%#gepheebase-summary-title</a> )	Experimental Evidence

	Taxon A	Taxon B	Position
Codon	-	-	-
Amino-acid	Ile	Met	17

Main Reference  
 Adaptive evolution of color vision as seen through the eyes of butterflies. (2007) (<https://pubmed.ncbi.nlm.nih.gov/17494749>)

Authors  
 Frentiu FD; Bernard GD; Cuevas CI; Sison-Mangus MP; Pradic KL; Briscoe AD

Abstract  
 Butterflies and primates are interesting for comparative color vision studies, because both have evolved middle- (M) and long-wavelength- (L) sensitive photopigments with overlapping absorbance spectrum maxima ( $\lambda_{max}$  values). Although positive selection is important for the maintenance of spectral variation within the primate pigments, it remains an open question whether it contributes similarly to the diversification of butterfly pigments. To examine this issue, we performed epimicrospectrophotometry on the eyes of five *Limenitis* butterfly species and found a 31-nm range of variation in the  $\lambda_{max}$  values of the L-sensitive photopigments (514–545 nm). We cloned partial *Limenitis* L opsin gene sequences and found a significant excess of replacement substitutions relative to polymorphisms among species. Mapping of these L photopigment  $\lambda_{max}$  values onto a phylogeny revealed two instances within Lepidoptera of convergently evolved L photopigment lineages whose  $\lambda_{max}$  values were blue-shifted. A codon-based maximum-likelihood analysis indicated that, associated with the two blue spectral shifts, four amino acid sites (Ile17Met, Ala64Ser, Asn70Ser, and Ser137Ala) have evolved substitutions in parallel and exhibit significant  $d(N)/d(S) > 1$ . Homology modeling of the full-length *Limenitis arthemis astyanax* L opsin placed all four substitutions within the chromophore-binding pocket. Strikingly, the Ser137Ala substitution is in the same position as a site that in primates is responsible for a 5- to 7-nm blue spectral shift. Our data show that some of the same amino acid sites are under positive selection in the photopigments of both butterflies and primates, spanning an evolutionary distance >500 million years.

Additional References

Mutation #2	Presumptive Null
No ( <a href="https://www.gepheebase.org/search-criteria/?and+Presumptive+Null=%No%#gepheebase-summary-title">https://www.gepheebase.org/search-criteria/?and+Presumptive+Null=%No%#gepheebase-summary-title</a> )	Molecular Type
Coding ( <a href="https://www.gepheebase.org/search-criteria/?and+Molecular+Type=%Coding%#gepheebase-summary-title">https://www.gepheebase.org/search-criteria/?and+Molecular+Type=%Coding%#gepheebase-summary-title</a> )	Aberration Type
SNP ( <a href="https://www.gepheebase.org/search-criteria/?and+Aberration+Type=%SNP%#gepheebase-summary-title">https://www.gepheebase.org/search-criteria/?and+Aberration+Type=%SNP%#gepheebase-summary-title</a> )	SNP Coding Change
Nonsynonymous	Molecular Details of the Mutation
I17M; S137A=S180A in human LWS/MWS numbering system	Experimental Evidence
Candidate Gene ( <a href="https://www.gepheebase.org/search-criteria/?and+Experimental+Evidence=%Candidate+Gene%#gepheebase-summary-title">https://www.gepheebase.org/search-criteria/?and+Experimental+Evidence=%Candidate+Gene%#gepheebase-summary-title</a> )	

	Taxon A	Taxon B	Position
Codon	-	-	-
Amino-acid	Ser	Ala	180

Main Reference  
 Adaptive evolution of color vision as seen through the eyes of butterflies. (2007) (<https://pubmed.ncbi.nlm.nih.gov/17494749>)

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[Additional References](#)

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## COMMENTS

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