

GEPHE SUMMARY

Luciferase (https://www.gephebase.org/search-criteria?/and+GeneGephebase=^luciferase^#gephebase-summary-title)	Gephebase Gene	GP00000554	GepheID
Published	Entry Status	Martin	Main curator

PHENOTYPIC CHANGE

Physiology (https://www.gephebase.org/search-criteria?/and+TraitCategory=^Physiology^#gephebase-summary-title)	Trait Category		
Bioluminescence spectrum (https://www.gephebase.org/search-criteria?/and+Trait=^Bioluminescence spectrum^#gephebase-summary-title)	Trait		
Pyrophorus plagiophthalmus - YE (ancestral) allele	Trait State in Taxon A		
Pyrophorus plagiophthalmus - YG allele	Trait State in Taxon B		
Data not curated	Ancestral State		
Intraspecific (https://www.gephebase.org/search-criteria?/and+TaxonomicStatus=^Intraspecific^#gephebase-summary-title)	Taxonomic Status		
	Taxon A		Taxon B
	Latin Name		Latin Name
Pyrophorus plagiophthalmus (https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=^Pyrophorus plagiophthalmus^#gephebase-summary-title)		Pyrophorus plagiophthalmus (https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=^Pyrophorus plagiophthalmus^#gephebase-summary-title)	
-	Common Name	-	Common Name
	Synonyms		Synonyms
Pyrophorus plagiophthalmus		Pyrophorus plagiophthalmus	
species	Rank	species	Rank
	Lineage		Lineage
cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Protostomia; Ecdysozoa; Panarthropoda; Arthropoda; Mandibulata; Pancrustacea; Hexapoda; Insecta; Dicondylia; Pterygota; Neoptera; Holometabola; Coleoptera; Polyphaga; Elateriformia; Elateroidea; Elateridae; Agrypninae; Pyrophorus		cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Protostomia; Ecdysozoa; Panarthropoda; Arthropoda; Mandibulata; Pancrustacea; Hexapoda; Insecta; Dicondylia; Pterygota; Neoptera; Holometabola; Coleoptera; Polyphaga; Elateriformia; Elateroidea; Elateridae; Agrypninae; Pyrophorus	
	Parent		Parent
Pyrophorus () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 30010)		Pyrophorus () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 30010)	
30011	NCBI Taxonomy ID	30011	NCBI Taxonomy ID
(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 30011)		(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 30011)	
is Taxon A an Intraspecies?		is Taxon B an Intraspecies?	
Yes		Yes	
	Taxon A Description		Taxon B Description
Pyrophorus plagiophthalmus - YE (ancestral) allele		Pyrophorus plagiophthalmus - YG allele	

GENOTYPIC CHANGE

-	Generic Gene Name	UniProtKB Photinus pyralis
-	Synonyms	P08659 (http://www.uniprot.org/uniprot/P08659)
-	String	GenebankID or UniProtKB
-		AAQ11735 (https://www.ncbi.nlm.nih.gov/nuccore/AAQ11735)
	Sequence Similarities	
Belongs to the ATP-dependent AMP-binding enzyme family.		
	GO - Molecular Function	
GO:0005524 : ATP binding (https://www.ebi.ac.uk/QuickGO/term/GO:0005524)		
GO:0046872 : metal ion binding (https://www.ebi.ac.uk/QuickGO/term/GO:0046872)		
GO:0051087 : chaperone binding (https://www.ebi.ac.uk/QuickGO/term/GO:0051087)		
GO:0047077 : Photinus-luciferin 4-monoxygenase (ATP-hydrolyzing) activity (https://www.ebi.ac.uk/QuickGO/term/GO:0047077)		
	GO - Biological Process	
GO:0008218 : bioluminescence (https://www.ebi.ac.uk/QuickGO/term/GO:0008218)		

Mutation #1

Presumptive Null

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

Molecular Type

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

Aberration Type

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

SNP Coding Change

Nonsynonymous

Molecular Details of the Mutation

nucleotides associated with colour: G667A; A668G; G712C; G798T; A844A; G847A in exon 4 and A1165G in exon 5 leading to several amino acid changes at the amino acid level: 90% of the colour difference between the yellow-green and yellow-emitting luciferases is due to two substitutions, R223E and L238V; the colour shift caused by L238V is about 1.3-fold greater than that of R223E. The remaining 10% of colour difference is due to one or more substitutions of L41I D226E V282I I283V V323I V389I

Experimental Evidence

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

	Taxon A	Taxon B	Position
Codon	-	-	-
Amino-acid	Arg	Glu	223

Main Reference

Darwinian natural selection for orange bioluminescent color in a Jamaican click beetle. (2003) (<https://pubmed.ncbi.nlm.nih.gov/14623957>)

Authors

Stolz U; Velez S; Wood KV; Wood M; Feder JL

Abstract

The Jamaican click beetle *Pyrophorus plagiophthalmus* (Coleoptera: Elateridae) is unique among all bioluminescent organisms in displaying a striking light color polymorphism [Biggley, W. H., Lloyd, J. E. & Seliger, H. H. (1967) *J. Gen. Physiol.* 50, 1681-1692]. Beetles on the island vary in the color of their ventral light organs from yellow-green to orange and their dorsal organs from green to yellow-green. The genetic basis for the color variation involves specific amino acid substitutions in the enzyme luciferase. Here, we show that dorsal and ventral light color in *P. plagiophthalmus* are under separate genetic control, we resolve the allelic basis for color variation, and, through analyses of luciferase sequence variation, we demonstrate that natural selection has produced a long-term adaptive trend for longer wavelength (more orange) ventral light on Jamaica. Our results constitute a novel example connecting the selective fixation of specific nucleotides in nature to their precisely determined phenotypic effects. We also present evidence suggesting that a recently derived ventral orange luciferase allele on the island has deterministically increased in frequency. Thus, the current luciferase polymorphism for *P. plagiophthalmus* appears to be mirroring the long-term anagenic trend on Jamaica, revealing a possible ongoing adaptive color transition in progress.

Additional References

Complementary DNA coding click beetle luciferases can elicit bioluminescence of different colors. (1989) (<https://pubmed.ncbi.nlm.nih.gov/2655091>)
Luc genes: introduction of colour into bioluminescence assays. (1990 Apr-Jun) (<https://pubmed.ncbi.nlm.nih.gov/2336971>)

Mutation #2

Presumptive Null

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

Molecular Type

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

Aberration Type

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

SNP Coding Change

Nonsynonymous

Molecular Details of the Mutation

nucleotides: G667A; A668G; G712C; G798T; A844A; G847A in exon 4 and A1165G in exon 5 leading to several amino acid changes amino acids: 90% of the colour difference between the yellow-green and yellow-emitting luciferases is due to two substitutions, R223E and L238V; the colour shift caused by L238V is about 1.3-fold greater than that of R223E. The remaining 10% of colour difference is due to one or more substitutions of L41I D226E V282I I283V V323I V389I

Experimental Evidence

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

	Taxon A	Taxon B	Position
Codon	-	-	-
Amino-acid	Leu	Val	238

Main Reference

Darwinian natural selection for orange bioluminescent color in a Jamaican click beetle. (2003) (<https://pubmed.ncbi.nlm.nih.gov/14623957>)

Authors

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demonstrate that natural selection has produced a long-term adaptive trend for longer wavelength (more orange) ventral light on Jamaica. Our results constitute a novel example connecting the selective fixation of specific nucleotides in nature to their precisely determined phenotypic effects. We also present evidence suggesting that a recently derived ventral orange luciferase allele on the island has deterministically increased in frequency. Thus, the current luciferase polymorphism for *P. plagiophthalmus* appears to be mirroring the long-term anagenic trend on Jamaica, revealing a possible ongoing adaptive color transition in progress.

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Luc genes: introduction of colour into bioluminescence assays. (1990 Apr-Jun) (<https://pubmed.ncbi.nlm.nih.gov/2336971>)

RELATED GEPHE

No matches found.

Related Genes

3 ([https://www.gephebase.org/search-criteria?/or+Gene+Gephebase="+luciferase+"/and+Taxon+ID="+30011"/or+Gene+Gephebase="+luciferase"/and+Taxon+ID="+30011"#gephebase-summary-title](https://www.gephebase.org/search-criteria?/or+Gene+Gephebase=))

Related Haplotypes

EXTERNAL LINKS

COMMENTS

@SeveralMutationsWithEffect