

GEPHE SUMMARY

hemoglobin; HBA2 (https://www.gephebase.org/search-criteria?/and+Gene+Gephebase=~hemoglobin; HBA2^#gephebase-summary-title)	Gephebase Gene	GP00000459	GepheID
Published	Entry Status	Martin	Main curator

PHENOTYPIC CHANGE

Physiology (https://www.gephebase.org/search-criteria?/and+Trait+Category=~Physiology^#gephebase-summary-title)	Trait Category		
Hypoxia response (https://www.gephebase.org/search-criteria?/and+Trait=~Hypoxia+response^#gephebase-summary-title)	Trait		
Anas flavirostris flavirostris	Trait State in Taxon A		
Anas flavirostris oxyptera	Trait State in Taxon B		
Taxon A	Ancestral State		
Intraspecific (https://www.gephebase.org/search-criteria?/and+Taxonomic+Status=~Intraspecific^#gephebase-summary-title)	Taxonomic Status		
	Taxon A		Taxon B
Anas flavirostris (https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=~Anas+flavirostris^#gephebase-summary-title)	Latin Name	Anas flavirostris (https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=~Anas+flavirostris^#gephebase-summary-title)	Latin Name
Yellow-billed teal	Common Name	Yellow-billed teal	Common Name
Yellow-billed teal; speckled teal; Anas flavirostris Vieillot, 1816	Synonyms	Yellow-billed teal; speckled teal; Anas flavirostris Vieillot, 1816	Synonyms
species	Rank	species	Rank
cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Deuterostomia; Chordata; Craniata; Vertebrata; Gnathostomata; Teleostomi; Euteleostomi; Sarcopterygii; Dipnotetrapodomorpha; Tetrapoda; Amniota; Sauropsida; Sauria; Archelosauria; Archosauria; Dinosauria; Saurischia; Theropoda; Coelurosauria; Aves; Neognathae; Galloanserae; Anseriformes; Anatidae; Anatinae; Anas	Lineage	cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Deuterostomia; Chordata; Craniata; Vertebrata; Gnathostomata; Teleostomi; Euteleostomi; Sarcopterygii; Dipnotetrapodomorpha; Tetrapoda; Amniota; Sauropsida; Sauria; Archelosauria; Archosauria; Dinosauria; Saurischia; Theropoda; Coelurosauria; Aves; Neognathae; Galloanserae; Anseriformes; Anatidae; Anatinae; Anas	Lineage
Anas (ducks) - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 8835)	Parent	Anas (ducks) - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 8835)	Parent
75845 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 75845)	NCBI Taxonomy ID	75845 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 75845)	NCBI Taxonomy ID
Yes	is Taxon A an Intraspecies?	Yes	is Taxon B an Intraspecies?
Anas flavirostris flavirostris	Taxon A Description	Anas flavirostris oxyptera	Taxon B Description

GENOTYPIC CHANGE

HBAD	Generic Gene Name	P02001 (http://www.uniprot.org/uniprot/P02001)	UniProtKB Gallus gallus
HBA2; HBAD	Synonyms	0	GenebankID or UniProtKB
9031.ENS GALP00000012054 (http://string-db.org/newstring.cgi/show_network_section.pl?identifier=9031.ENS GALP00000012054)	String		
Belongs to the globin family.	Sequence Similarities		
GO:0020037 : heme binding (https://www.ebi.ac.uk/QuickGO/term/GO:0020037)	GO - Molecular Function		
GO:0005506 : iron ion binding (https://www.ebi.ac.uk/QuickGO/term/GO:0005506)			
GO:0005344 : oxygen carrier activity (https://www.ebi.ac.uk/QuickGO/term/GO:0005344)			
GO:0043177 : organic acid binding (https://www.ebi.ac.uk/QuickGO/term/GO:0043177)			

GO:0019825 : oxygen binding (<https://www.ebi.ac.uk/QuickGO/term/GO:0019825>)
GO - Biological Process

GO:0098869 : cellular oxidant detoxification
(<https://www.ebi.ac.uk/QuickGO/term/GO:0098869>)
GO:0042744 : hydrogen peroxide catabolic process
(<https://www.ebi.ac.uk/QuickGO/term/GO:0042744>)
GO:0051291 : protein heterooligomerization
(<https://www.ebi.ac.uk/QuickGO/term/GO:0051291>)

GO - Cellular Component

GO:0031838 : haptoglobin-hemoglobin complex
(<https://www.ebi.ac.uk/QuickGO/term/GO:0031838>)
GO:0005833 : hemoglobin complex (<https://www.ebi.ac.uk/QuickGO/term/GO:0005833>)

Presumptive Null

No ([#gpebase-summary-title](https://www.gephebase.org/search-criteria?/and+Presumptive+Null+No))

Molecular Type

Coding ([#gpebase-summary-title](https://www.gephebase.org/search-criteria?/and+Molecular+Type+Coding))

Aberration Type

SNP ([#gpebase-summary-title](https://www.gephebase.org/search-criteria?/and+Aberration+Type+SNP))

SNP Coding Change

Nonsynonymous

Molecular Details of the Mutation

Ser130Phe

Experimental Evidence

Candidate Gene ([#gpebase-summary-title](https://www.gephebase.org/search-criteria?/and+Experimental+Evidence+Candidate+Gene))

	Taxon A	Taxon B	Position
Codon	-	-	-
Amino-acid	-	-	-

Main Reference

Convergent Evolution of Hemoglobin Function in High-Altitude Andean Waterfowl Involves Limited Parallelism at the Molecular Sequence Level. (2015)
(<https://pubmed.ncbi.nlm.nih.gov/26637114>)

Authors

Natarajan C; Projecto-Garcia J; Moriyama H; Weber RE; Muñoz-Fuentes V; Green AJ; Kopuchian C; Tubaro PL; Alza L; Bulgarella M; Smith MM; Wilson RE; Fago A; McCracken KG; Storz JF

Abstract

A fundamental question in evolutionary genetics concerns the extent to which adaptive phenotypic convergence is attributable to convergent or parallel changes at the molecular sequence level. Here we report a comparative analysis of hemoglobin (Hb) function in eight phylogenetically replicated pairs of high- and low-altitude waterfowl taxa to test for convergence in the oxygenation properties of Hb, and to assess the extent to which convergence in biochemical phenotype is attributable to repeated amino acid replacements. Functional experiments on native Hb variants and protein engineering experiments based on site-directed mutagenesis revealed the phenotypic effects of specific amino acid replacements that were responsible for convergent increases in Hb-O₂ affinity in multiple high-altitude taxa. In six of the eight taxon pairs, high-altitude taxa evolved derived increases in Hb-O₂ affinity that were caused by a combination of unique replacements, parallel replacements (involving identical-by-state variants with independent mutational origins in different lineages), and collateral replacements (involving shared, identical-by-descent variants derived via introgressive hybridization). In genome scans of nucleotide differentiation involving high- and low-altitude populations of three separate species, function-altering amino acid polymorphisms in the globin genes emerged as highly significant outliers, providing independent evidence for adaptive divergence in Hb function. The experimental results demonstrate that convergent changes in protein function can occur through multiple historical paths, and can involve multiple possible mutations. Most cases of convergence in Hb function did not involve parallel substitutions and most parallel substitutions did not affect Hb-O₂ affinity, indicating that the repeatability of phenotypic evolution does not require parallelism at the molecular level.

Additional References

RELATED GEPHE

Related Genes

3 (EGLN1, EPAS1, hemoglobin; HBB) (<https://www.gephebase.org/search-criteria?/or+Taxon+ID+75845#/and+Trait+Hypoxia+response/and+groupHaplotypes=true#gpebase-summary-title>)

Related Haplotypes

1 (<https://www.gephebase.org/search-criteria?/or+Gene+Gephebase+hemoglobin;+HBA2#/and+Taxon+ID+75845#/or+Gene+Gephebase+hemoglobin;+HBA2#/and+Taxon+ID+75845#gpebase-summary-title>)

EXTERNAL LINKS

COMMENTS

Needs curation

