

GEPHE SUMMARY

hemoglobin; HBA2 (https://www.gephebase.org/search-criteria?/and+GeneGephebase=~hemoglobin; HBA2^#gephebase-summary-title)	Gephebase Gene	GepheID
	GP00000458	
	Entry Status	Martin
Published		Main curator

PHENOTYPIC CHANGE

Physiology (https://www.gephebase.org/search-criteria?/and+TraitCategory=~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+TaxonomicStatus=~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	Latin Name
Yellow-billed teal		Common Name	Common Name
Yellow-billed teal; speckled teal; Anas flavirostris Vieillot, 1816		Synonyms	Synonyms
species		Rank	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	Lineage
Anas (ducks) - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 8835)		Parent	Parent
75845 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 75845)		NCBI Taxonomy ID	NCBI Taxonomy ID
is Taxon A an Intraspecies?			is Taxon B an Intraspecies?
Yes			
Taxon A Description		Taxon B Description	
Anas flavirostris flavirostris		Anas flavirostris oxyptera	

GENOTYPIC CHANGE

HBA1		Generic Gene Name	UniProtKB Homo sapiens
HBH; ECYT7; HBA-T3; METHBA		Synonyms	GenebankID or UniProtKB
9606.ENSPP00000322421 (http://string-db.org/newstring.cgi/show_network_section.pl?identifier=9606.ENSPP00000322421)		String	ACT81051 (https://www.ncbi.nlm.nih.gov/nuccore/ACT81051)
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:0006898 : receptor-mediated endocytosis
(<https://www.ebi.ac.uk/QuickGO/term/GO:0006898>)
GO:0042542 : response to hydrogen peroxide
(<https://www.ebi.ac.uk/QuickGO/term/GO:0042542>)
GO:0015701 : bicarbonate transport (<https://www.ebi.ac.uk/QuickGO/term/GO:0015701>)
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:0015671 : oxygen transport (<https://www.ebi.ac.uk/QuickGO/term/GO:0015671>)
GO:0010942 : positive regulation of cell death
(<https://www.ebi.ac.uk/QuickGO/term/GO:0010942>)
GO:0051291 : protein heterooligomerization
(<https://www.ebi.ac.uk/QuickGO/term/GO:0051291>)

GO - Cellular Component

GO:0005829 : cytosol (<https://www.ebi.ac.uk/QuickGO/term/GO:0005829>)
GO:0016020 : membrane (<https://www.ebi.ac.uk/QuickGO/term/GO:0016020>)
GO:0070062 : extracellular exosome (<https://www.ebi.ac.uk/QuickGO/term/GO:0070062>)
GO:0005576 : extracellular region (<https://www.ebi.ac.uk/QuickGO/term/GO:0005576>)
GO:0005615 : extracellular space (<https://www.ebi.ac.uk/QuickGO/term/GO:0005615>)
GO:0072562 : blood microparticle (<https://www.ebi.ac.uk/QuickGO/term/GO:0072562>)
GO:0071682 : endocytic vesicle lumen
(<https://www.ebi.ac.uk/QuickGO/term/GO:0071682>)
GO:0022627 : cytosolic small ribosomal subunit
(<https://www.ebi.ac.uk/QuickGO/term/GO:0022627>)
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 (<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

Ala77Thr

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	-	-	-

Main Reference

Parallel evolution in the major haemoglobin genes of eight species of Andean waterfowl. (2009) (<https://pubmed.ncbi.nlm.nih.gov/19754505>)

Authors

McCracken KG; Barger CP; Bulgarella M; Johnson KP; Sonsthagen SA; Trucco J; Valqui TH; Wilson RE; Winker K; Sorenson MD

Abstract

Theory predicts that parallel evolution should be common when the number of beneficial mutations is limited by selective constraints on protein structure. However, confirmation is scarce in natural populations. Here we studied the major haemoglobin genes of eight Andean duck lineages and compared them to 115 other waterfowl species, including the bar-headed goose (*Anser indicus*) and Abyssinian blue-winged goose (*Cyanochen cyanopterus*), two additional species living at high altitude. One to five amino acid replacements were significantly overrepresented or derived in each highland population, and parallel substitutions were more common than in simulated sequences evolved under a neutral model. Two substitutions evolved in parallel in the alpha A subunit of two (Ala-alpha 8) and five (Thr-alpha 77) taxa, and five identical beta A subunit substitutions were observed in two (Ser-beta 4, Glu-beta 94, Met-beta 133) or three (Ser-beta 13, Ser-beta 116) taxa. Substitutions at adjacent sites within the same functional protein region were also observed. Five such replacements were in exterior, solvent-accessible positions on the A helix and AB corner of the alpha A subunit. Five others were in close proximity to inositolpentaphosphate binding sites, and two pairs of independent replacements occurred at two different alpha(1)beta(1) intersubunit contacts. More than half of the substitutions in highland lineages resulted in the acquisition of serine or threonine (18 gains vs. 2 losses), both of which possess a hydroxyl group that can hydrogen bond to a variety of polar substrates. The patterns of parallel evolution observed in these waterfowl suggest that adaptation to high-altitude hypoxia has resulted from selection on unique but overlapping sets of one to five amino acid substitutions in each lineage.

Additional References

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>)

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#gephebase-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"#gephebase-summary-title](https://www.gephebase.org/search-criteria?/or+Gene+Gephebase=))

EXTERNAL LINKS

COMMENTS

Needs curation