GEPHE SUMMARY

Gephebase Gene
Fads2 (https://www.gephebase.org/search-criteria?/and+Gene Gephebase=^Fads2^#gephebase-summary-title)

GepheID
GP00002053

Entry Status
Published

Main curator
Courtier

PHENOTYPIC CHANGE

Trait Category
Physiology (https://www.gephebase.org/search-criteria?/and+Trait Category=^Physiology^#gephebase-summary-title)

Trait
Fatty acid metabolism (fatty acid desaturation) (https://www.gephebase.org/search-criteria?/and+Trait=^Fatty acid metabolism (fatty acid desaturation)^#gephebase-summary-title)

Trait State in Taxon A
Low physiological ability to survive in freshwater DHA free diets

Trait State in Taxon B
High physiological ability to survive in freshwater DHA free diets

Ancestral State
Taxon A

Taxonomic Status
Interspecific (https://www.gephebase.org/search-criteria?/and+Taxonomic Status=^Interspecific^#gephebase-summary-title)

Taxon A

Latin Name
Pungitius pungitius (https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=^Pungitius pungitius^#gephebase-summary-title)

Common Name
ninespine stickleback

Synonyms
Gasterosteus pungitius; ninespine stickleback; Gasterosteus pungitius Linnaeus, 1758; Pungitius pungitius (Linnaeus, 1758)

Rank
species

Lineage
cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Deuterostomia; Chordata; Craniata; Vertebrata; Gnathostomata; Teleostomi; Euteleostomi; Actinopterygii; Actinopteri; Neopterygii; Teleostei; Osteoglossocephalai; Clupeocephala; Euteleosteomorpha; Neoteleostei; Eurypterygia; Ctenosquamata; Acanthomorphata; Euacanthomorphacea; Percomorphaceae; Eupercaria; Perciformes; Cottioidei; Gasterosteales; Gasterosteidae; Pungitius

Parent
Pungitius () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 134919)

NCBI Taxonomy ID
134920 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 134920)

is Taxon A an Infraspecies?
No

Taxon B #1

Latin Name
Pungitius tymensis (https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=^Pungitius tymensis^#gephebase-summary-title)

Common Name
Sakhalin sticlkeback

Synonyms
Gasterosteus tymensis; Sakhalin sticlkeback; Gasterosteus tymensis Nikolskii, 1889; Pungitius tymensis (Nikolskii, 1889)

Rank
species

Lineage
cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Deuterostomia; Chordata; Craniata; Vertebrata; Gnathostomata; Teleostomi; Euteleostomi; Actinopterygii; Actinopteri; Neopterygii; Teleostei; Osteoglossocephalai; Clupeocephala; Euteleosteomorpha; Neoteleostei; Eurypterygia; Ctenosquamata; Acanthomorphata; Euacanthomorphacea; Percomorphaceae; Eupercaria; Perciformes; Cottioidei; Gasterosteales; Gasterosteidae; Pungitius

Parent
Pungitius () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 134919)

NCBI Taxonomy ID
1480064 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 1480064)

is Taxon B an Infraspecies?
No

Taxon B #2

Latin Name
Pungitius kaibarae (https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=^Pungitius kaibarae^#gephebase-summary-title)

Common Name
-

Synonyms
Amur stickleback; Pygosteus kaibarae; Pungitius kaibarae (Tanaka, 1915); Pygosteus kaibarae Tanaka, 1915

Rank
species

Lineage
cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Deuterostomia; Chordata; Craniata; Vertebrata; Gnathostomata; Teleostomi; Euteleostomi; Actinopterygii; Actinopteri; Neopterygii; Teleostei; Osteoglossocephalai; Clupeocephala; Euteleosteomorpha; Neoteleostei; Eurypterygia; Ctenosquamata; Acanthomorphata; Euacanthomorphacea; Percomorphaceae;

Eupercaria; Perciformes; Cottioidei; Gasterosteales; Gasterosteidae; Pungitius

Parent

Pungitius () - (Rank: genus)
(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 134919)

NCBI Taxonomy ID

300318
(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 300318)

is Taxon B an Infraspecies?

No

GENOTYPIC CHANGE

Generic Gene Name

fads2

Synonyms

Fadsd6; DRD5/D6; wu:fb64c04; wu:fb69e08; zgc:112502; fadsd6

String

7955.ENSDARP00000022396
(http://string-db.org/newstring_cgi/show_network_section.pl?identifier=
7955.ENSDARP00000022396)

Sequence Similarities

Belongs to the fatty acid desaturase type 1 family.

GO - Molecular Function

GO:0016213 : linoleoyl-CoA desaturase activity
(https://www.ebi.ac.uk/QuickGO/term/GO:0016213)

GO - Biological Process

GO:0006636 : unsaturated fatty acid biosynthetic process
(https://www.ebi.ac.uk/QuickGO/term/GO:0006636)
GO:0001889 : liver development (https://www.ebi.ac.uk/QuickGO/term/GO:0001889)

GO - Cellular Component

GO:0016021 : integral component of membrane
(https://www.ebi.ac.uk/QuickGO/term/GO:0016021)
GO:0005789 : endoplasmic reticulum membrane
(https://www.ebi.ac.uk/QuickGO/term/GO:0005789)

UniProtKB Danio rerio

Q9DEX7 (http://www.uniprot.org/uniprot/Q9DEX7)

GenebankID or UniProtKB

()

Presumptive Null

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

Molecular Type

Gene Amplification (https://www.gephebase.org/search-criteria?/and+Molecular Type=^Gene Amplification^#gephebase-summary-title)

Aberration Type

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

Insertion Size

1-10 kb

Molecular Details of the Mutation

higher number of copies of Fads2.

Experimental Evidence

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

Main Reference

A key metabolic gene for recurrent freshwater colonization and radiation in fishes. (2019) (https://pubmed.ncbi.nlm.nih.gov/31147520)

Authors

Ishikawa A; Kabeya N; Ikeya K; Kakioka R; Cech JN; Osada N; Leal MC; Inoue J; Kume M; Toyoda A; Tezuka A; Nagano AJ; Yamasaki YY; Suzuki Y; Kokita T; Takahashi H; Lucek K; Marques D; Takehana Y; Naruse K; Mori S; Monroig O; Ladd N; Schubert CJ; Matthews B; Peichel CL; Seehausen O; Yoshizaki G; Kitano J

Abstract

Colonization of new ecological niches has triggered large adaptive radiations. Although some lineages have made use of such opportunities, not all do so. The factors causing this variation among lineages are largely unknown. Here, we show that deficiency in docosahexaenoic acid (DHA), an essential Ï‰-3 fatty acid, can constrain freshwater colonization by marine fishes. Our genomic analyses revealed multiple independent duplications of the fatty acid desaturase gene Fads2 in stickleback lineages that subsequently colonized and radiated in freshwater habitats, but not in close relatives that failed to colonize. Transgenic manipulation of Fads2 in marine stickleback increased their ability to synthesize DHA and survive on DHA-deficient diets. Multiple freshwater ray-finned fishes also show a convergent increase in Fads2 copies, indicating its key role in freshwater colonization.

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Additional References

RELATED GEPHE

Related Genes

No matches found.

Related Haplotypes

No matches found.

EXTERNAL LINKS

COMMENTS

Both P. tymensis and P. kaibarae are entirely freshwater species. Pungitius sinensis; which inhabits both freshwater and brackish environments; has Fads2 copy numbers intermediate between those of P. pungitius and freshwater nine-spined sticklebacks