

## Supplemental Table Legends

**Table S1. List of HIF $\alpha$  sequences used for phylogenetic analyses.** For each sequence, the organism name (species and common name) and order (*sensu* Hughes et al. 2018) are given. Gene name, aliases, Gene ID, mRNA accession, protein accession, and gene and protein statistics are from GenBank, except for three-spined stickleback (*Gasterosteus aculeatus*) which are from Ensemble. The gene group is based upon the phylogenetic and synteny analyses reported here (figure 1, electronic supplementary material, table S2). When multiple variants were identified within a locus, the longest form was selected. **NOTE:** data for spotted gar (*Lepisosteus oculatus*) HIF1 $\alpha$  were generated by concatenation of two partial sequences (Gene ID 107077742 and 102694568).

**Table S2. Synteny analysis of Actinopterygian HIF $\alpha$  subunits.** The ten flanking genes on either side of each HIF $\alpha$  subunit were determined for spotted gar (*L. oculatus*), Asian arowana (*S. formosus*), representative Otocephala (*D. rerio* and *A. mexicanus*), northern pike (*E. lucius*), rainbow trout (*O. mykiss*), and representative Neoteleost (*X. maculatus* and *T. rubripes*). Flanking genes shared between spotted gar HIF1 $\alpha$  and both HIF1 $\alpha$  paralogs in more derived fishes are highlighted in dark blue, genes shared between spotted gar HIF1 $\alpha$  and HIF1 $\alpha$ a are highlighted in medium blue, and genes shared between spotted gar HIF1 $\alpha$  and HIF1 $\alpha$ b are highlighted in light blue. Flanking genes shared between spotted gar HIF2 $\alpha$  and both HIF2 $\alpha$  paralogs in more derived fishes are highlighted in dark green, genes shared between spotted gar HIF2 $\alpha$  and HIF2 $\alpha$ a are highlighted in medium green, and genes shared between spotted gar HIF2 $\alpha$  and HIF2 $\alpha$ b are highlighted in light green. In addition, genes shared among HIF2 $\alpha$ b, but not present in spotted gar, are highlighted in yellow. Flanking genes shared between spotted gar HIF3 $\alpha$  and HIF3 $\alpha$  from more derived species are highlighted in orange. Flanking genes shared between spotted gar HIF4 $\alpha$  and HIF4 $\alpha$  from more derived species are highlighted in purple. Gene ID, chromosomal or linkage group assignment, mRNA accession, and protein accession are from GenBank. Gene orientation indicated by the forward or reverse arrow heads (-> or <-).

**Table S3. Exon number and deduced protein length of Actinopterygian HIF $\alpha$  subunits.** HIF $\alpha$  group is based upon phylogenetic analysis (figure 1) and synteny (figure 2, electronic supplementary material, table S2). Within each HIF $\alpha$ , species are grouped according to phylogeny (Hughes et al. 2018). The number of species in each group is indicated, along with the minimum, maximum, and median values for exon number and amino acid number for the deduced protein sequence. When multiple variants were identified within a locus, the longest form was selected. Data for spotted gar (*Lepisosteus oculatus*) are not included.



Species	Common Name	Order	Genbank or Ensemble Gene Name	Group	Aliases	Gene ID (Genbank)	Chromosome #	Exons	mRNA Accession No.	Protein Accession No.	Protein Length (aa)
<i>Oryzias latipes</i>	Japanese ricefish	Belontiiformes	hypoxia-inducible factor 1 subunit alpha, like	HIF3A	hif1a	1011165163	13	16	XM_004075255	XP_004075303	650
<i>Poecilia reticulata</i>	guppy	Cyprinodontiformes	hypoxia inducible factor 1 subunit alpha a	HIF1Aa	hif1aa	103458897	LG22	15	XM_008400026	XP_008398248	764
<i>Poecilia reticulata</i>	guppy	Cyprinodontiformes	endothelial PAS domain-containing protein 1-like	HIF2Aa	epas1	103476630	LG15	9	XM_017308890	XP_017164379	557
<i>Poecilia reticulata</i>	guppy	Cyprinodontiformes	endothelial PAS domain protein 1a	HIF2Ab	epas1, epas1a	103481538	LG19	9	XM_008437064	XP_008435286	370
<i>Poecilia reticulata</i>	guppy	Cyprinodontiformes	hypoxia-inducible factor 1 subunit alpha, like	HIF3A	hif1a	103475214	LG13	14	XM_008426661	XP_008424883	674
<i>Salmo salar</i>	Atlantic salmon	Salmoniformes	hypoxia-inducible factor 1-alpha	HIF1Aa_s1	hif1a	106598919	ssa01	15	XM_014189950	XP_014045425	762
<i>Salmo salar</i>	Atlantic salmon	Salmoniformes	hypoxia-inducible factor 1-alpha-like	HIF1Aa_s2	hif1a	106610969	ssa09	15	XM_014210723	XP_014066198	802
<i>Salmo salar</i>	Atlantic salmon	Salmoniformes	endothelial PAS domain protein 1	HIF2Aa_s1	epas1	106589722	ssa28	16	XM_014179994	XP_014035469	853
<i>Salmo salar</i>	Atlantic salmon	Salmoniformes	endothelial PAS domain-containing protein 1-like	HIF2Aa_s2	epas1	106611028	ssa01	17	XM_014210842	XP_014066317	854
<i>Salmo salar</i>	Atlantic salmon	Salmoniformes	hypoxia-inducible factor 1-alpha	HIF3A_s1	hif1a	100194993	ssa20	16	NM_001134022	NP_001133494	628
<i>Salmo salar</i>	Atlantic salmon	Salmoniformes	hypoxia-inducible factor 1-alpha-like	HIF3A_s2	hif1a	106612598	ssa09	15	XM_014213898	XP_014069373	633
<i>Salmo salar</i>	Atlantic salmon	Salmoniformes	hypoxia-inducible factor 1 subunit alpha, like 2	HIF4A	hif1a2	106563688	ssa11	12	XM_014129489	XP_013984964	725
<i>Salvelinus alpinus</i>	arctic char	Salmoniformes	hypoxia-inducible factor 1-alpha	HIF1Aa_s1	hif1a	111968658	LG9	14	XM_023994425	XP_023850193	756
<i>Salvelinus alpinus</i>	arctic char	Salmoniformes	hypoxia-inducible factor 1-alpha	HIF1Aa_s2	hif1a	111963342	LG4q.2	16	XM_023986707	XP_023842475	759
<i>Salvelinus alpinus</i>	arctic char	Salmoniformes	endothelial PAS domain protein 1	HIF2Aa_s1	epas1	111968049	LG8	17	XM_023993573	XP_023849341	853
<i>Salvelinus alpinus</i>	arctic char	Salmoniformes	endothelial PAS domain-containing protein 1-like	HIF2Aa_s2	epas1l	112073362	Un	15	XM_024140674	XP_023996442	849
<i>Salvelinus alpinus</i>	arctic char	Salmoniformes	hypoxia-inducible factor 1-alpha	HIF3A_s1	hif1a	111982824	LG22	15	XM_024014433	XP_023870201	629
<i>Salvelinus alpinus</i>	arctic char	Salmoniformes	hypoxia-inducible factor 1-alpha	HIF3A_s2	hif1a	111949752	LG22	16	XM_023967103	XP_023822871	659
<i>Salvelinus alpinus</i>	arctic char	Salmoniformes	hypoxia inducible factor 1 subunit alpha, like 2	HIF4A	hif1a2, npas1	111964361	LG5	12	XM_023988241	XP_023844009	721
<i>Scleropages formosus</i>	Asian arowana	Osteoglossiformes	hypoxia inducible factor 1 subunit alpha a	HIF1Aa	hif1a, hif1aa	108919562	15	15	XM_018727619	XP_018583135	762
<i>Scleropages formosus</i>	Asian arowana	Osteoglossiformes	endothelial PAS domain protein 1b	HIF2Aa	epas1, epas1b	108942753	8	18	XM_018766230	XP_018621746	881
<i>Scleropages formosus</i>	Asian arowana	Osteoglossiformes	hypoxia inducible factor 1 subunit alpha, like	HIF3A	hif1a	108928738	10	19	XM_018742811	XP_018598327	628
<i>Scleropages formosus</i>	Asian arowana	Osteoglossiformes	hypoxia inducible factor 1 subunit alpha, like 2	HIF4A	hif1a2	108934068	4	15	XM_018751566	XP_018607082	711
<i>Takifugu rubripes</i>	torafugu	Tetraodontiformes	hypoxia inducible factor 1 subunit alpha a	HIF1Aa	hif1a, hif1aa	101071027	2	15	XM_003962474	XP_003962523	755
<i>Takifugu rubripes</i>	torafugu	Tetraodontiformes	endothelial PAS domain protein 1b	HIF2Aa	epas1, epas1b	101067536	4	16	XM_011603052	XP_011601354	854
<i>Takifugu rubripes</i>	torafugu	Tetraodontiformes	endothelial PAS domain protein 1	HIF2Ab	epas1	101073099	1	9	XM_003976888	XP_003976937	359
<i>Takifugu rubripes</i>	torafugu	Tetraodontiformes	hypoxia inducible factor 1 subunit alpha, like	HIF3A	hif1a	101062698	11	16	XM_029843274	XP_029699134	676
<i>Xiphophorus maculatus</i>	southern platyfish	Cyprinodontiformes	hypoxia inducible factor 1 subunit alpha	HIF1Aa	hif1aa	102217674	19	15	XM_023325292	XP_023208360	758
<i>Xiphophorus maculatus</i>	southern platyfish	Cyprinodontiformes	endothelial PAS domain protein 1b	HIF2Aa	epas1, epas1b	102218651	22	16	XM_023326963	XP_023182731	867
<i>Xiphophorus maculatus</i>	southern platyfish	Cyprinodontiformes	endothelial PAS domain protein 1a	HIF2Ab	epas1, epas1a	102227739	10	9	XM_005794777	XP_005794834	409
<i>Xiphophorus maculatus</i>	southern platyfish	Cyprinodontiformes	hypoxia inducible factor 1 subunit alpha, like	HIF3A	hif3a, hif1a2	102223582	18	15	XM_005811977	XP_005811204	650



Gene Group	Fish Group	Count	Exons (MIN)	Exons (MAX)	Exons (MEDIAN)	Amino Acids (MIN)	Amino Acids (MAX)	Amino Acids (MEDIAN)
HIF1Aa	Asian arowana	1	15	15	15	762	762	762
HIF1Aa	Otocephala	5	14	15	15	611	748	717
HIF1Aa_s1	Salmoniformes	5	14	15	14	756	766	762
HIF1Aa_s2	Salmoniformes	5	15	16	15	758	802	768
HIF1Aa	Neoteleostei	9	15	16	15	748	774	758
HIF1Ab	Otocephala	5	14	16	15	774	798	777
HIF2Aa	Asian arowana	1	18	18	18	881	881	881
HIF2Aa	Otocephala	5	10	17	16	565	912	834
HIF2Aa_s1	Salmoniformes	5	16	18	16	852	853	853
HIF2Aa_s2	Salmoniformes	5	13	17	16	845	854	849
HIF2Aa	Neoteleostei	9	9	18	16	557	881	860
HIF2Ab	Otocephala	5	10	17	16	459	845	816
HIF2Ab	Salmoniformes	2	5	9	7	232	391	312
HIF2Ab	Neoteleostei	8	8	9	9	359	409	370
HIF3A	Asian arowana	1	19	19	19	628	628	628
HIF3A	Otocephala	5	15	17	15	626	646	633
HIF3A_s1	Salmoniformes	5	14	16	15	572	676	628
HIF3A_s2	Salmoniformes	4	14	16	15	630	659	632
HIF3A	Neoteleostei	9	12	16	15	649	679	662
HIF4A	Asian arowana	1	15	15	15	711	711	711
HIF4A	Otocephala	5	14	15	14	606	708	663
HIF4A	Salmoniformes	5	12	13	12	721	725	724