

Last annotation of *Fugu rubripes* at JGI

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- Read the [online help](#) to find information about how to use the data, visualization and search tools.

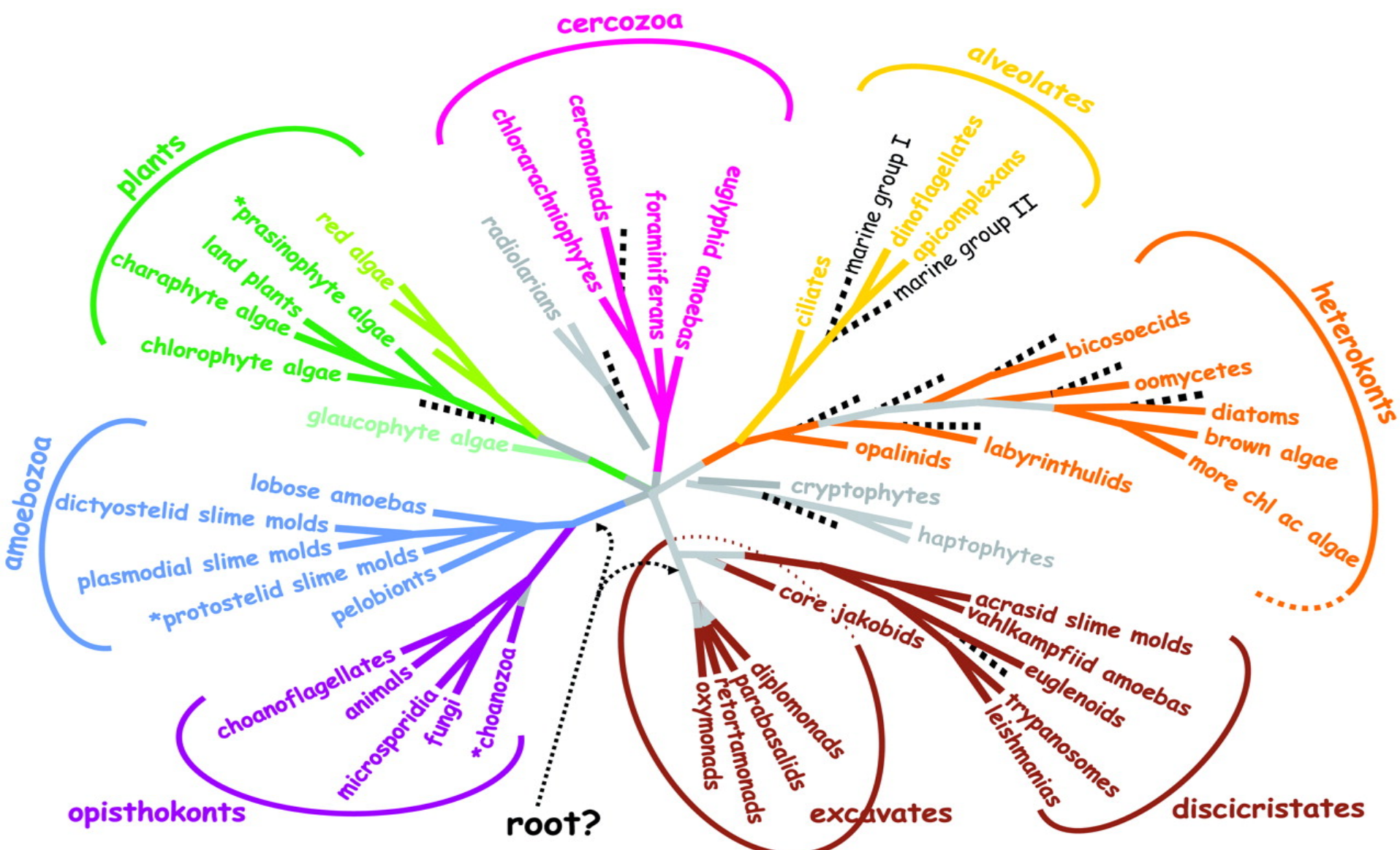
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Eukaryotic Highlights

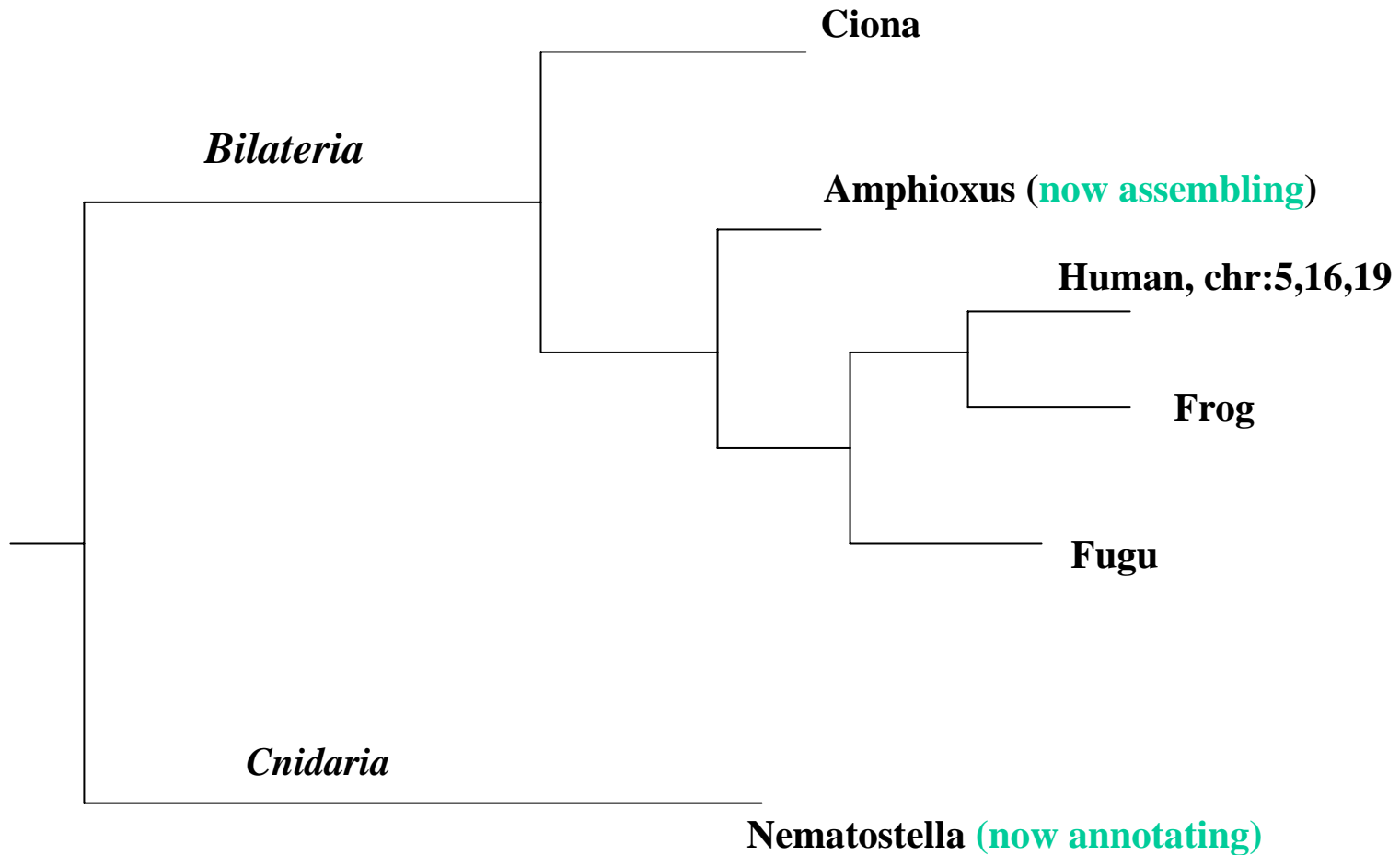
Chlamydomonas reinhardtii is a single celled chlorophyte. Highly adaptable, these green algae live in many different environments throughout the world. The relative adaptability and quick generation time has made *Chlamydomonas* an important model for biological research.

Internet

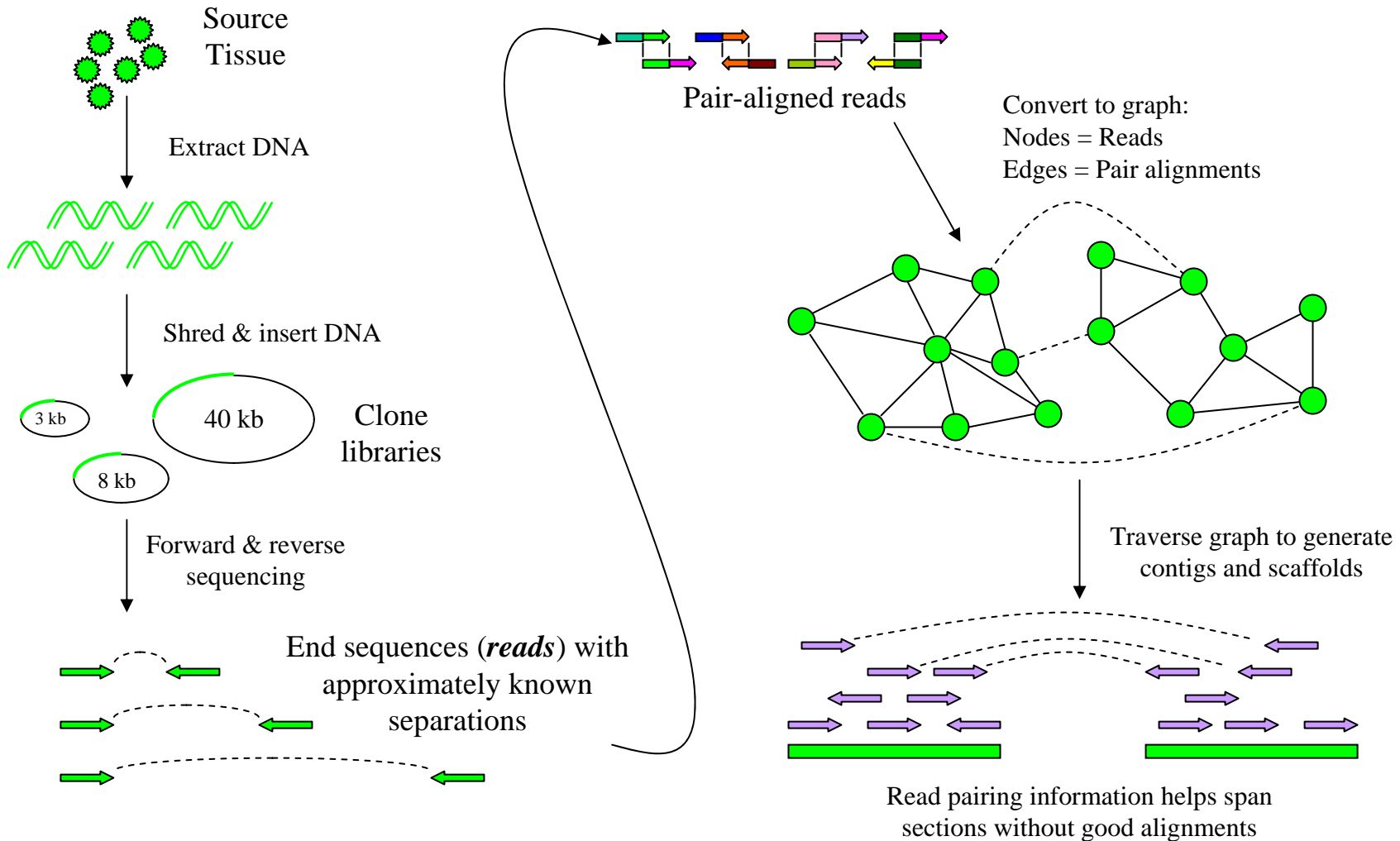
Phylogeny of eukaryotes (Baldauf, Science, 2003)



Animal (metazoan) genomes at JGI



Outline of the Assembly Process: JAZZ, the JGI In-House Assembler



Fugu Assembly Statistics

	v.2 (Aparacio et al 2002)	v.4 (Oct, 2004)
Coverage	5.4X	8.5X
Number of used reads	3,71 mln	6,92 mln
Scaffold Total	12,381	7,213
Scaffold Sequence Total	322.5 MB	393.3 MB
Scaffold N50	745 scaffolds account for 35% of sequence	125
Scaffold L50		858KB
Contig Total	45024	31213
Contig Sequence Total	332.5 MB (3% gap)	351.2 MB (10.6% gap)

Annotation Pipeline

Genome assembly

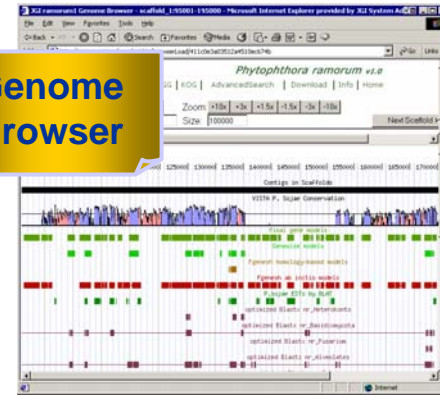
Gene prediction

Fgenesh

Genewise

Others

Genome Browser



Validation & consolidation

Homology

ESTs

Completeness

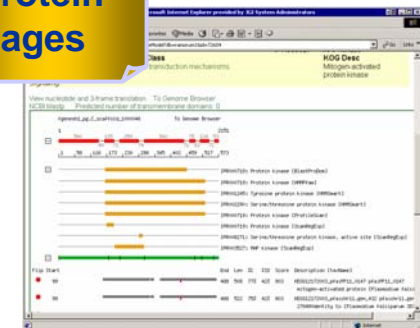
Functional Annotation

Homology

Domains

Structure

Protein Pages



Classification

GO

KEGG

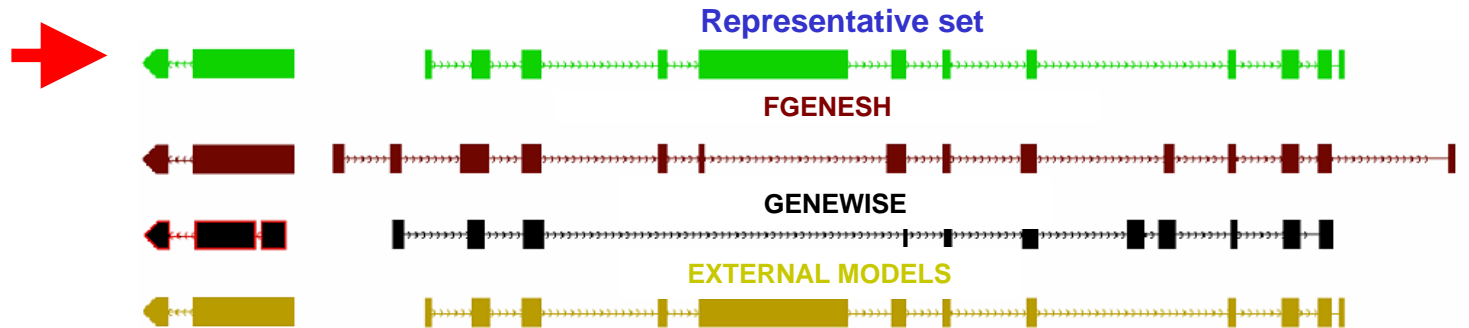
KOG

Methods used for fugu annotation at JGI

- Genewise
- Fgenesh-kg: Mapping of known genes, mRNAs, cDNAs
- Fgenesh-pm: Predictions using protein homologs
- Fgenesh-pg: Ab-initio predictions, with parameters tuned for fugu genome
- Fgenesh-est: Predictions using EST information

All predicted gene models, where possible, were EST extended into UTRs

Model selection



In order to produce a representative, non-redundant set of gene models, for every set of overlapping models, we select “the best” model according the following parameters:

- **Modified alignment score [$S' = S * CVR1 * CVR2$] of the best blast hit,**
- **EST coverage,**
- **Model completeness,**
- **Length of the protein/transcript**

This representative set is the first automatically generated version of a Gene Catalog, which the can be modified manually.

Genome Browser

JGI T. (Fugu) rubripes v4.0 (Takru4) Genome Browser - scaffold_1:1-100000 - Microsoft Internet Explorer

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JGI *Fugu rubripes v4.0*

Search | BLAST | Browse | GO | KEGG | KOG | AdvancedSearch | Download | Info | Home | **HELP!**

Move: <<< << < > >> >>> Zoom: +10x +3x +1.5x -1.5x -3x -10x (+) Ref. Strand Refresh >

Position: scaffold_1:1-100000 Size: 100000 Next Scaffold >>

Feature: Get Scaffold Info

/Close Toolbar [Link to this view](#) **Help**

Base Position 10000| 20000| 30000| 40000| 50000| 60000| 70000| 80000| 90000| 100000

VistaXentr3 Frog (Xenopus tropicalis) Vista Conservation curve (Xentr3)

VistaDanre Zebrafish (Danio rerio) Vista Conservation curve (Danre)

VistaTetni7 Pufferfish (Tetraodon nigricans) Vista Conservation (Tetni7)

scaffold_1 Contigs in Scaffolds

Gene models release, v4.1

FilteredModels6

allBonyFishCDNA BLAT

ZebrafishCDNA BLAT

allFuguCDNA BLAT

otherFishESTs BLAT

ZebrafishEST BLAT

nr_Danioerrio Blastx

nr_Actinopterygii Blastx

ipi_Ratnovegicus Blastx

ipi_Homosapiens Blastx

ipi_Musmusculus Blastx

nr_Xenopus Blastx

Fraction of conserved sequence in Fugu relative to Tetraodon and Zebrafish (according to Vista)

Similarity	Tetraodon	Zebrafish
>70%	85.3 Mb (22%)	7.2 MB (1.8%)
>80%	49.1 Mb (12.5%)	2.3 Mb (0.6%)
>90%	15.6 Mb (4%)	0.2 Mb (0.06%)

Genome Browser/ProteinPages

The image displays two overlapping browser windows. The background window is the JGI Genome Browser for *Fugu rubripes* v4.0 (Takru4), showing a scaffold view of scaffold_1:1-100000. The foreground window is the ProteinPages interface for *Phytophthora ramorum* v1.0, displaying a protein model for a kinase gene.

ProteinPages Interface:

- Navigation:** Search, BLAST, Browse, GO, KEGG, KOG, Adv.
- Position:** scaffold_1:1-100000
- Feature:** Get Scaffold Info
- Buttons:** <<<, <<, <, >, >>, >>>

Protein Model Summary:

KOG GROUP	KOG Id	KOG Class	KOG Desc
Cellular Processes And Signaling	KOG0660	Signal transduction mechanisms	Mitogen-activated protein kinase

Gene Model and Domains:

View nucleotide and 3-frame translation To Genome Browser
 NCBI blastp Predicted number of transmembrane domains: 0

Gene: fgenesh1_pg.C_scaffold1_1000046 To Genome Browser

Protein length: 2151 amino acids. Domains are indicated by colored bars above the gene model.

IPR ID	Description
IPR000719	Protein kinase [BlastProDom]
IPR000719	Protein kinase [HMMPfam]
IPR001245	Tyrosine protein kinase [HMMSmart]
IPR002290	Serine/threonine protein kinase [HMMSmart]
IPR000719	Protein kinase [ProfileScan]
IPR000719	Protein kinase [ScanRegExp]
IPR008271	Serine/threonine protein kinase, active site [ScanRegExp]
IPR003527	MAP kinase [ScanRegExp]

Sequence Alignment Table:

Flip Start	End	Len	%C	%I	Score	Description [taxName]
99	488	508	77%	42%	803	KEGG12172003_pfa:PF11_0147 pfa:PF11_0147 mitogen-activated protein [Plasmodium falci
99	488	522	75%	42%	803	KEGG12172003_pfa:chr11.gen_432 pfa:chr11.gen_27648identity to [Plasmodium falciparum 3D7

BLAST Results:

- ipi_Homosapiens Blastx
- ipi_Musmusculus Blastx
- nr_Xenopus Blastx

KOG/GO/KEGG

KOG Classification



SEARCH BY KOG ID SEARCH BY KOG KEYWORD

CELLULAR PROCESSES AND SIGNALING

<input checked="" type="checkbox"/>	M	Cell wall/membrane/envelope biogenesis	32 gene models
<input checked="" type="checkbox"/>	N	Cell motility	4 gene models
<input checked="" type="checkbox"/>	O	Posttranslational modification, protein turnover, chaperones	374 gene models
<input checked="" type="checkbox"/>	T	Signal transduction mechanisms	240 gene models
<input checked="" type="checkbox"/>	U	Intracellular trafficking, secretion, and vesicular transport	204 gene models
<input checked="" type="checkbox"/>	V	Defense mechanisms	14 gene models
<input checked="" type="checkbox"/>	W	Extracellular structures	3 gene models
<input checked="" type="checkbox"/>	Y	Nuclear structure	36 gene models
<input checked="" type="checkbox"/>	Z	Cytoskeleton	104 gene models
Total Gene Count			1011

INFORMATION STORAGE AND PROCESSING

[D] GO:0003673 Gene_Ontology (Poptr1:24206)

[D] [P] GO:0003674 molecular_function (22998)

[D] [I] GO:0003824 catalytic_activity (13605)

[D] [I] GO:0016740 transferase_activity (5037)

[D] [I] GO:0016772 transferase_activity, transferring phosphorus-containing groups (3341)

[D] [I] GO:0016773 phosphotransferase_activity, alcohol group as acceptor (2691)

[D] [I] GO:0004672 protein_kinase_activity (2461)

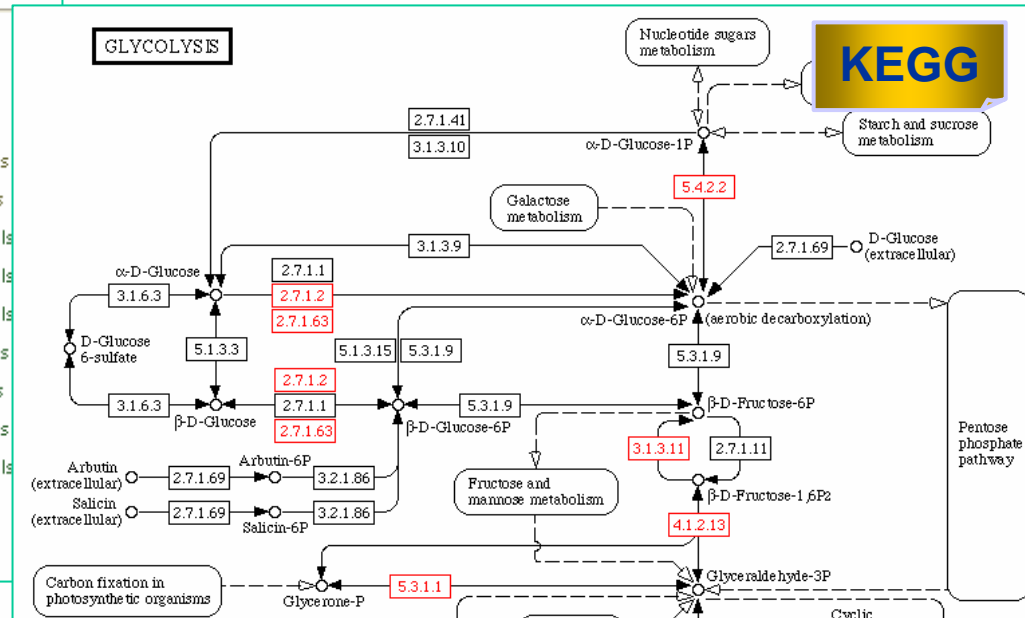
[D] [I] GO:0004674 protein_serine/threonine_kinase_activity (2048)

[D] [I] GO:0004712 protein_threonine/tyrosine_kinase_activity (631)

[D] [I] GO:0004673 protein-histidine_kinase_activity (77)

[D] [I] GO:0004713 protein-tyrosine_kinase_activity (1955)

[D] [I] GO:0019199 transmembrane_receptor_protein_kinase_activity (631)



METABOL

Summary of JGI annotations for Fugu v.4

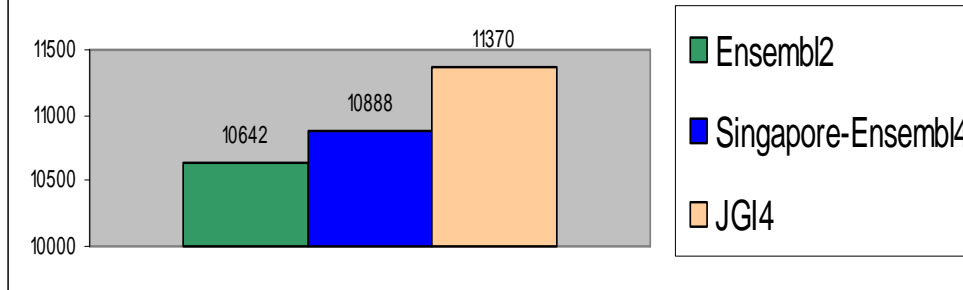
Number of gene models	26721
Number of gene models with UTR	2757 (~10%)
Average number of exons per gene	7.8
Average gene size (bp)	5690
Average CDS size(bp)	1345
Average exon size (bp)	172

JGI annotations were compared with IMCB Singapore Annotations v.4 (22,008 genes) and Ensembl annotations v.2 (20,706 genes)

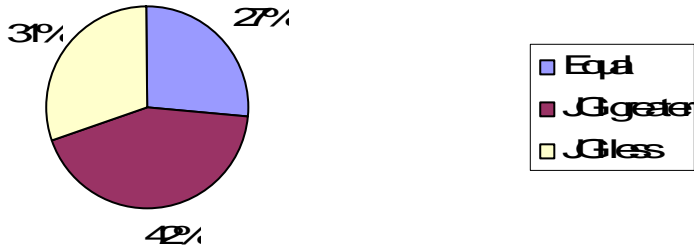
Comparison between JGI4 and Singapore4 annotations

- Total number of gene models: 26721 (JGI), 22008 (Singapore)
- ~10% (2228) of predicted genes exactly coincide
- ~26% (5633) of predicted genes are coincide without considering terminal exons
- ~70% (105,673) of internal exons coincide
- From 5143 gene models missed by Singapore, but predicted by JGI – 1361 contain some Pfam domains
- From 1107 gene models missed by JGI, but predicted by Singapore – 336 have some Pfam domains (but many of them related to repeats)

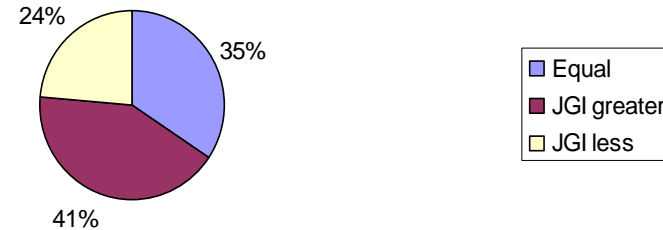
Number of putative orthologs, based on reciprocal Blastp best hits, between Fugu and Human annotations (22,218 gene models from Ensembl release 35)



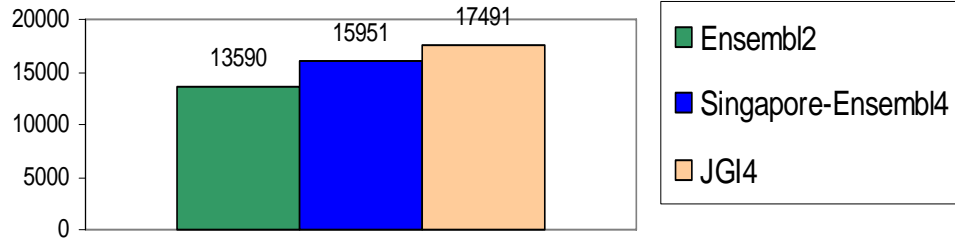
Comparison of BLASTP scores of Ensembl2 and JGI4 on 980 common 'orthologous' pairs from Human



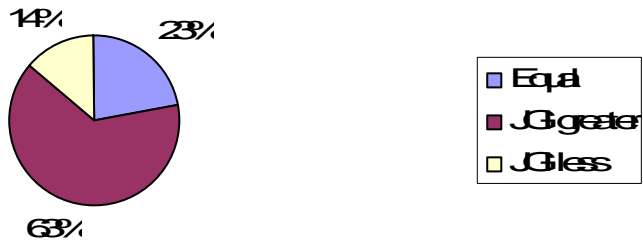
Comparison of BLASTP scores of Singapore4 and JGI4 on 10268 common 'orthologous' pairs from Human



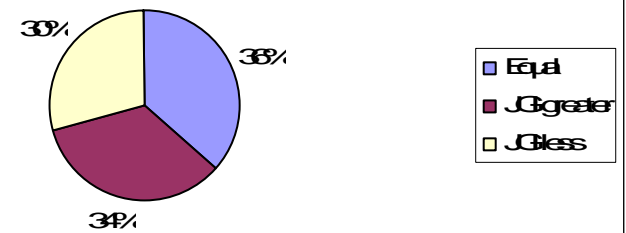
Number of putative orthologs, based on reciprocal Blastp best hits, between Fugu and Tetraodon annotations (28,005 gene models from Ensembl Tetraodon7)



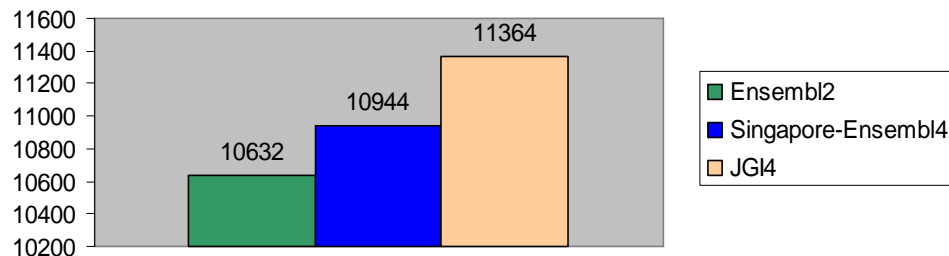
Comparison of BLASTP scores of Ensembl2 and JGI4 on 12831 common orthologous pairs from Tetraodon



Comparison of BLASTP scores of Singapore4 and JGI4 on 14,776 common orthologous pairs from Tetraodon



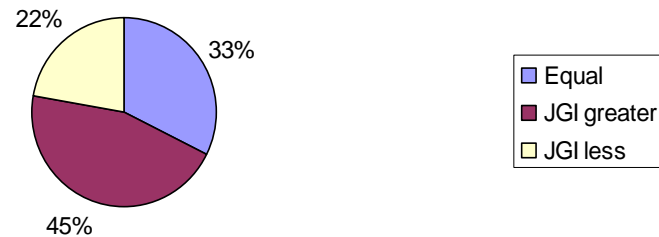
Number of putative ortologs, based on reciprocal Blastp best hits, between Fugu and Zebrafish annotations (22,877 gene models from Ensembl)



Comparison of BLASTP scores of Ensembl2 and JGI4 on 970 common 'ortologous' pairs from Zebrafish



Comparison of BLASTP scores of Singapore4 and JGI4 on 10178 common 'ortologous' pairs from Zebrafish



Pfam domain comparison between different annotations

JGI4 vs. Ensembl2

- 1546 domains occur at equal numbers in both sets
- 981 domains occur more frequently at JGI annotations (from them 145 are uniquely)
- 180 domains occur more frequently at Ensemble2 (from them 44 uniquely)

Pfam domain comparison between different annotations

JGI4 vs. Ensembl2

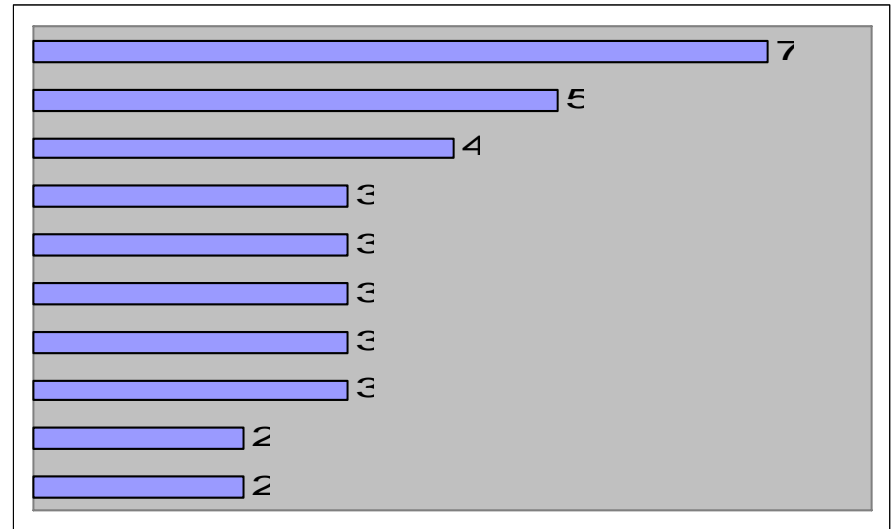
- 1546 domains occur at equal numbers in both sets
- 981 domains occur more frequently at JGI annotations (from them 145 are uniquely)
- 180 domains occur more frequently at Ensembl2 (from them 44 uniquely)

JGI4 vs. Singapore4

- 1788 domains occur at equal numbers in both sets
- 723 domains occur more frequently at JGI annotations (from them 109 uniquely)
- 195 domains occur more frequently at Singapore4 annotations (from them 43 uniquely)

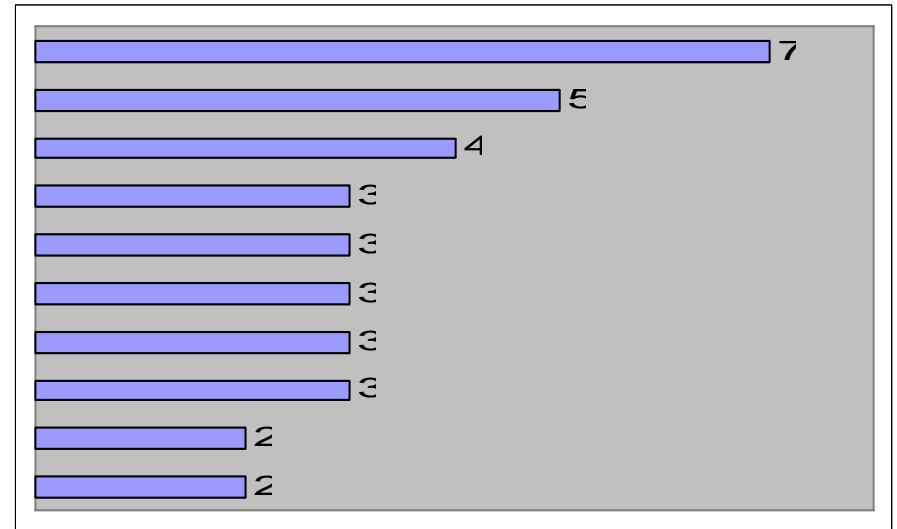
10 Most frequent PFAM domains absent in Ensembl2 annotations

uPARLy6obrain
FXADDAFMFiindbrain
Raphilin3Aeffectorobrain
Heinlysintypecalciumbindingrepeat (2copies)
NAD-Ubiquinone(plastoquinone(complexI), variouschains
Vertebrateembryonouspichidneuropeptide
BESSnotif
Poly(ADP-ribose) glycohydrolase(PARG)
NUMBpreyldairerichregion
Autophagyproteinassociatedprotein, Glomerulobrain



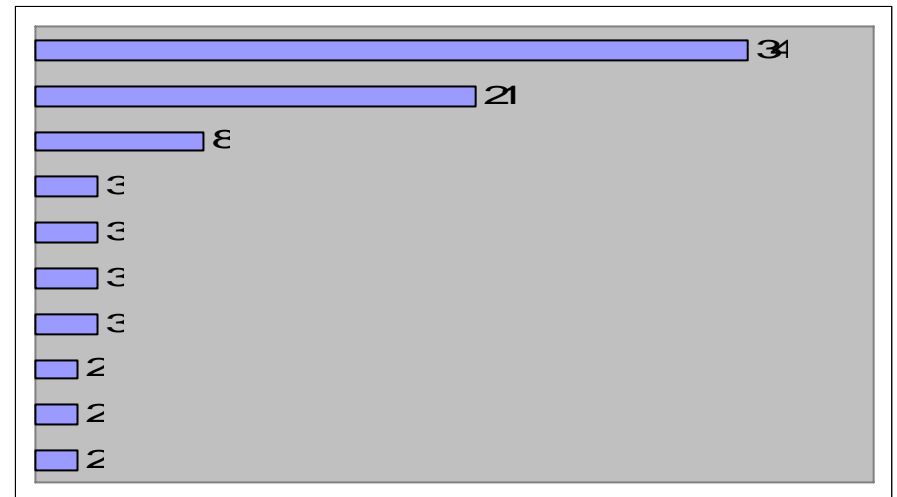
10 Most frequent PFAM domains absent in Ensembl2 annotations

uPARLy6cbnain
FXADDATMPrindbnain
Raphilin3Aeffectorcbnain
Hebrylinsintypicalcalciumbindingrepeat (2copies)
NAD-Ubiquinone(ubiquinone(complexI), variouschains)
Vertebrateembryonicopiodsneuropeptide
BESSnotif
Poly(ADP-ribose)glycohydrolase(PARG)
NUMBphenylalaninerichregion
Autophagyassociatedprotein, Glutinalcbnain



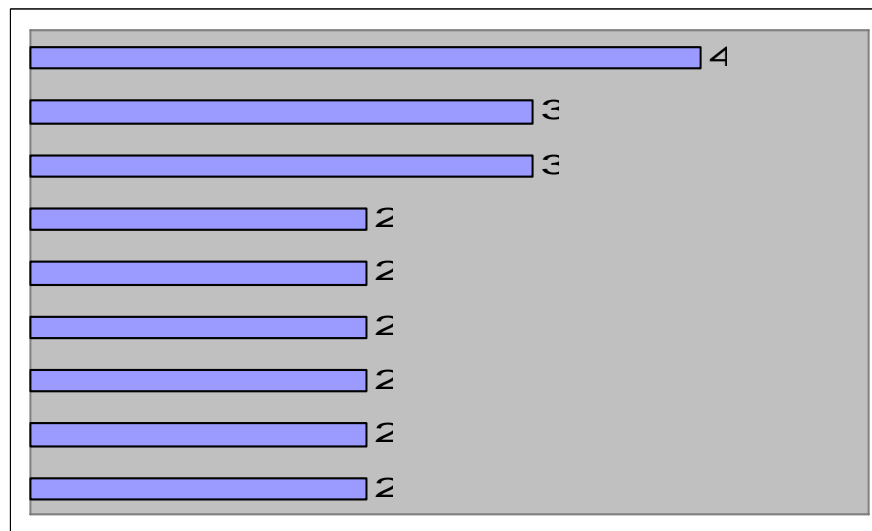
10 Most frequent PFAM domains absent in JGI annotations

Integrasecorecbnain
Reverse transcriptase (RNA dependent DNA polymerase)
Retroviral capsid ptease
CE1 pdecorecoreNteninus, S2likecbnain
CE1 pdecorecoreNteninalcbnain1
Transposase
CE1 pdecorecoreNteninus, EFlardlikecbnain
Methionine
Retrotransposon gag protein
PtdanireP1



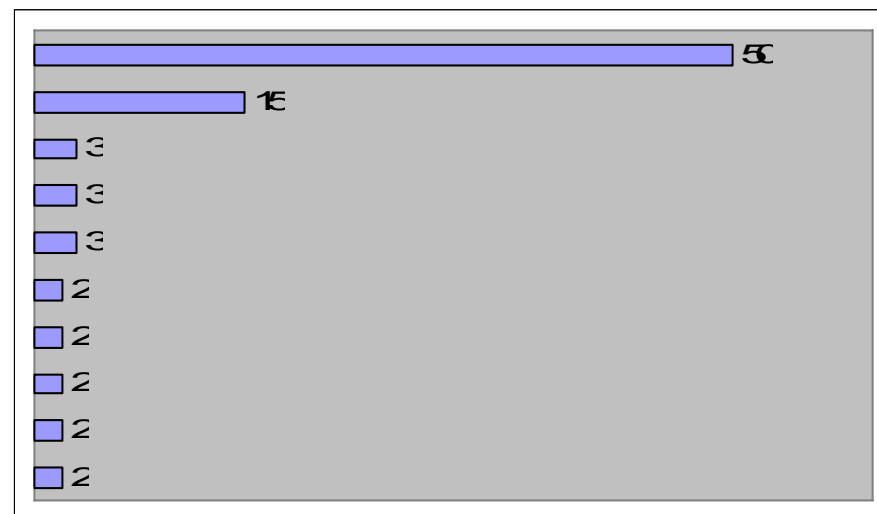
10 Most frequent PFAM domains absent in Singapore annotations

Tyrosin beta4 family
Hemolysin type calcium binding repeat (2 copies)
NAD-Ubiquinone (ubiquinone (complex I), various chains)
Mitochondrial-associated glycoprotein (MAGP)
Leishmanidin
CYT H domain
tRNA intron endonuclease, catalytic domain
GLT repeat (6 copies)
Bombesin-like peptide
Transcription initiation factor III F, beta subunit

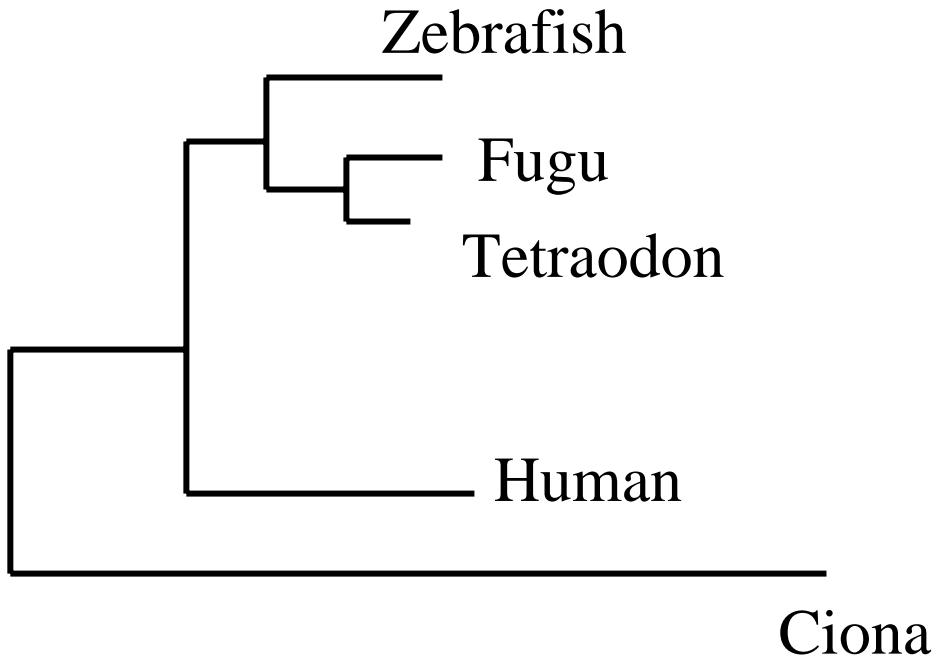


10 Most frequent PFAM domains absent in JGI annotations

Integrase core domain
RNA setranscriptase (RNA dependent DNA polymerase)
CB_p100 oncogene N terminus, S2-like domain
CB_p100 oncogene N terminal domain 1
CB_p100 oncogene N terminus, EF hand-like domain
Prophosphonate kinase
Transposase
ES family
DF-zinc finger
Retroviral aspartyl protease



NJ-tree (Phylip) based on Pfam domain content distances



FR					
TN	37				
DR	56	55			
HS	73	70	75		
CI	138	121	132	128	
	FR	TN	DR	HS	CI

Detection of possibly ‘missed’ genes based on Pfam domain profile

5 domains are in fugu (FR), but present in human(HS), Zebrafish (DR), tetraodon (TN) and ciona (CI)

HS	DR	FR	TN	CI	
1	2	0	1	1	PF07572 BCNT Bucentaur or craniofacial development
1	1	0	2	1	PF01263 Aldose_epim Aldose 1-epimerase
1	2	0	1	1	PF07065 D123 D123
1	1	0	1	1	PF02733 Dak1 Dak1 domain
1	1	0	1	1	PF01876 RNase_P_p30 RNase P subunit p30

76 domains are absent in tetraodon (TN), but present in human(HS), fugu (FR) and ciona (CI)

HS	DR	FR	TN	CI	
2	3	4	0	1	PF03332 PMM Eukaryotic phosphomannomutase
2	2	2	0	4	PF03015 Sterile Male sterility protein
2	3	3	0	1	PF05915 DUF872 Eukaryotic protein of unknown function (DUF872)
3	2	2	0	1	PF05207 zf-CSL CSL zinc finger
2	2	2	0	1	PF01127 Sdh_cyt Succinate dehydrogenase cytochrome b subunit
2	3	1	0	1	PF02936 COX4 Cytochrome c oxidase subunit IV
3	2	1	0	1	PF03943 TAP_C TAP C-terminal domain
1	1	1	0	3	PF03199 GSH_synthase Eukaryotic glutathione synthase
2	2	1	0	1	PF01765 RRF Ribosome recycling factor
1	1	1	0	3	PF05724 TPMT Thiopurine S-methyltransferase (TPMT)
2	1	1	0	1	PF01025 GrpE GrpE
1	2	1	0	1	PF05024 Gpi1 N-acetylglucosaminyl transferase component (Gpi1)
1	2	1	0	1	PF02348 CTP_transf_3 Cytidylyltransferase
1	1	2	0	1	PF05060 MGAT2 N-acetylglucosaminyltransferase II (MGAT2)
1	2	1	0	1	PF02441 Flavoprotein Flavoprotein

156 domains are absent in zebrafish (DR), but present in human(HS), fugu (FR) and ciona (CI)

HS	DR	FR	TN	CI	
11	0	2	2	2	PF03184 DDE DDE superfamily endonuclease
4	0	5	4	2	PF06814 Lung_7-TM_R Lung seven transmembrane receptor
3	0	4	4	3	PF04675 DNA_ligase_A_N DNA ligase
3	0	3	3	3	PF04567 RNA_pol_Rpb2_5 RNA polymerase Rpb2
2	0	4	3	3	PF00464 SHMT Serine hydroxymethyltransferase
2	0	3	3	2	PF02516 STT3 Oligosaccharyl transferase STT3 subunit
3	0	3	3	1	PF03836 RasGAP_C RasGAP C-terminus
2	0	2	2	3	PF02010 REJ REJ domain
2	0	2	1	3	PF03942 DTW DTW domain
2	0	2	2	2	PF02515 CoA_transf_3 CoA-transferase family III
2	0	2	2	2	PF01142 TruD tRNA pseudouridine synthase D (TruD)
2	0	3	2	1	PF05822 UMPH-1 Pyrimidine 5'-nucleotidase (UMPH-1)
2	0	2	2	2	PF02969 TAF TATA box binding protein associated factor (TAF)
1	0	2	1	2	PF01464 SLT Transglycosylase SLT domain
1	0	1	1	2	PF05090 VKG_Carbox Vitamin K-dependent gamma-carboxylase

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