

SUPPLEMENTARY FIGURE 4: Clustal Omega alignment of representative DNA-PKcs sequences from all major phyla (short list). DNA-PKcs sequences from representative species from all major phyla were compiled and analysed by Clustal Omega using default settings. The % sequence ID is from Clustal Omega. In the alignment, identical amino acids are indicated by * (blue/bold), highly conserved amino acids by : (blue), and similar amino acids by . (purple). The human sequence is highlighted in yellow. The catalytic amino acids are in red and the autophosphorylation sites and highlighted in blue. For additional information on organisms and scientific names please see Supplementary Table 1.

Sequence	Genus Species	Alternate name/identifier	Percent ID
HUMAN	<i>H. sapiens</i>		100
ESHARK	<i>Callorhinchus milii</i>	Elephant shark	62.31
LANCELET	<i>Branchiostoma belcheri</i>		43.54
STARFISH	<i>Acanthaster planci</i>		42.49
STONYCORAL	<i>Stylophora pistillata</i>		41.25
LINGULA	<i>Lingula anatina</i>	Brachiopod	39.64
LIMPET	<i>Lottia gigantea</i>		39.55
TRICHOPLAX	<i>Trichoplax sp.</i>	Placazoa	38.78
SPONGE	<i>Amphimedon queenslandica</i>		35.51
SCORPION	<i>Centruroides sculpturatus</i>		34.07
ROTIFER	<i>Brachionus plicatilis</i>		32.79
TERMITE	<i>Cryptotermes secundus</i>		30.31
SALPINGOECA	<i>Salpingoeca rosetta</i>	Choanoflagellate	30.18
SHRIMP	<i>Penaeus vannamei</i>		29.76
GLOMUS	<i>Glomus cerebriforme</i>	Fungus	28.88
HETEROSTELIUM	<i>Heterostelium album PN500</i>	Amoeba	27.87
MOSS	<i>Physcomitrella patens</i>	Simple plant	27.39
TRICHINELLA	<i>Trichinella pseudospiralis</i>	Roundworm	27.05
FLATWORM	<i>Macrostomum lignano</i>	Platyhelminth	26.63
STYLONCHIA	<i>Stylonychia lemnae</i>	Ciliate	23.79
APHANOMYCESe	<i>Aphanomyces euteiches</i>	Oomycete	23.19

Supplementary Figure 4: CLUSTAL All phyla small

CLUSTAL O(1.2.4) multiple sequence alignment

APHANOMYCESE	----MNDKSNRFKELDRALHQLYNIASS-KD-----VEVDKDTI	34
FLATWORM	-----MSS-----DDIRFV---IDKFLKD-----PELKES	22
STYLONCHIA	-----MEQIDELLRQLHKFLFA-----DS	20
TRICHINELLA	-----MAYSTVDRIRDALNSLKDFIEG-----ADSDQA	28
HETEROSTELIUM	MFKMNMNVDISIYQRIDGYLVKHLQSVGGTTSTTATTATAAITSASGGNSNNFSAIDKD	60
GLOMUS	----MSGL----DTLQKCLQELANCRQNIQV-----KSSFGEAVGEA	34
MOSS	-----MDKQLGSCLASLRDAAD--SV-----RSSGGFVDL	28
TERMITE	-----MMG-----SELIGFVEVINSCISG-----NHLNKYIEA	28
SALPINGOECA	----MAAAR--SELERLCRNLEEQRLS-----ASPRRFIAA	30
ROTIFER	-----MNDLEKHIQNLPDLSL-----NSNVDA	23
SHRIMP	----MAGGGREEELDLLGKLGQSFPGP-----NGQGDPA	32
SCORPION	-----MNEITNSLHENILKLNDFIKYQKD-----EGHS----S	29
SPONGE	-----MESRIESLWESLHSSSP-----QR-YSYA	23
HUMAN	----MAGSG--AGVRCSLRLRQETLSA-A-----DRCGAALAG	31
ESHARK	----MAGPRGAAADTLSAFASKLHLLSL-S-----DVKSAAES	34
LIMPET	----MAS-----GLLEESLRDLHANLKD-----GGQSELDQI	28
LINGULA	----MA-----GNLQDLLCTLHSCVGGEEE-----DARGGR-KT	29
TRICHOPLAX	----MA-----SNLSQLLIDLHALL-N-LQ-----SLHRGS-NA	27
STONYCORAL	----MS-----DLLNRYLTHLHS-LPS-LD-----APHCGL-DA	27
STARFISH	----MAT-----ADLPVKLSENLGLIST-KS-----GLHVAE-KA	29
LANCELET	----MAGS-----GSLEARLSELHALLAE-SD-----HGHGAV-EA	30
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APHANOMYCESE	ESAVTTLFRRATRNLSLESRAAAEKCCSRLFHGS-SGPTPSLLDILQLQDTGLRKYATLL	93
FLATWORM	KALFNVIFNEF--ASSNENFKHNKYLAIFDEP-EGLVYRLQSKE---VSE--DA----	69
STYLONCHIA	EQVVNELRIYI-LDESLKEADLAFISSKIFNSN-SLLEFLRENSLHNDKLISV----	73
TRICHINELLA	EDCVQQIFNHF-HKLNSEFNFGFCFNSLLSNDNSLLSILSSSIGKTAFAQT-----	80
HETEROSTELIUM	GMLIEQLSNVV--LKELAEDIQVAASLFLHGD-HNLLKFLERSVLINTKDMIKL----	112
GLOMUS	LRYSDQIDHIV--SNDIEDQELGLATQLLFDPO-IGIIFLNDTSRVTDVSLAKA----	86
MOSS	APYVVDFSEL--KDLYSDEDISYAIIVFDED-TGIFSILESLLRVRDKSVVRA----	80
TERMITE	KSNISNIISYF--EDKRKRDTLDGAFVLFDDK-TGILQFIQKALKQDAFTEA-----	78
SALPINGOECA	AAIVADIAAYT--RTLTTPELALAASILGSD-QGVLDFLRQ-LGLELYEEC-----	79
ROTIFER	KSIVLDIVYLC--GENLNPQTITFCLSLFFKRE-KNLLTFLRKTITRDEFRC-----	73
SHRIMP	KDVIVDIAELL--AVDLTPAQYDLYISQVL-GE-KGIITFGRSVSKDQSFVEA-----	81
SCORPION	IYVIKDISEIC-LRGTLEKDRSYVCSLILRKE-DGFLHFLEEAVNTPSLKDS-----	80
SPONGE	TEVASDLYSLC--VEQITESELAYSSSVLFNPD-NGILKFLHDVTTLEEFASC-----	73
HUMAN	HQLIRGLGQEC--VLSSSPAVLALQTSLVFSRD-FGLLVFVRKSLNSIEFREC-----	81
ESHARK	HSAVGSISRDF-RCSSSDSQLALQSSMVFSD-TGLLVFLRKLRFEEFRDS-----	85
LIMPET	DSIVPTLSQIC--LHEITEKDIDYCSSVLFDE-IGVTTFLQKISKKNEYQGSNA----	80
LINGULA	FDLVRDIANLC--LKETSRETDYCSSLFLNFKD-TGLVSVFVKKVVKQAEYDST-----	79
TRICHOPLAX	CDIASDITVLC--LQTASDAEKAYCSSALFGQD-YGVVTFLRKSIIGLDDLDKC-----	77
STONYCORAL	SNTVVDLGSFC--LENVSSEQAYSSLLFSGE-TSIVSFLRKVITLDEFQDA-----	77
STARFISH	QDLVVDLGHLC--LRQLESENLAYCCSOLFNDK-NGILVFLNKAIKDELKGS-----	79
LANCELET	HNLVADIAQIC--LRHTAERDVAYCCSVLFQES-TGITAFLRKTVTLDQYLP-----	80
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APHANOMYCESE	AFTLEHLVTFKDMHDTI-RQSLASHVETLVPTCCNVLTSSQMASKRSEAGYLVKYSVK	152
FLATWORM	---KKGDLDFLTKLIAQSPALLATS-LPKVKCLAESLFPSSISSAKVRIASLNCISICFK	125
STYLONCHIA	---KKKVYELIIDYLLKLR-SQEATPYLKLKLDL-CLRSFRSDHNSLVKESLQLLIKIE	128
TRICHINELLA	---IVYGIDIIRLAIKAT-TSLSPSHRKAIMRF-TLRLKQDYLKGRREV----VLYLAN	131
HETEROSTELIUM	---KTSILNLSKLIKSF-KLQVADYVVPKSI-CISLFRDQSPVQAATFEPQKILH	167
GLOMUS	---KIALLEFLFLYIRKI-QSDIEPYTEIKNV-HFGILNVDDAEFVKAASFPMAMLD	141
MOSS	---RESCWSFLALFIKKI-GPRALHYAALLKEK-SLTFFRREDSKSVQAAALTPILIVLE	135
TERMITE	---IKESFTLLKQLIDVF-KERMSCHVVQIKDL-CKTCILLEKKAEEKDKAFDVIQSVLE	133
SALPINGOECA	---KVAALEFLAGFIQRLPADRLTPYAVRIKDT-CLTFC-RDKRAKVKSLSFKPLIALFS	134
ROTIFER	---KVDLLQFLKFIKITS-A-EKKILPSPDIKDT-CILLFSSDKYSVDRCATFISIKILE	128
SHRIMP	---KKSTLDVLTLLDKE-AQKINRYVDDIRKY-TLYLYNVEKSTKVQAAALEVFTLLA	136
SCORPION	---LIEALQFLNLFINI-GNKVVQYGITVKDV-VFSIFLRNQLAKVKILALSALIKVLE	135
SPONGE	---KEELLKLSNFVKNL-SRRVLSHIVPITDV-CVFIEMREKSAKVNATLNLINTLE	128
HUMAN	---REEILKFLCIFLEKM-GQKIAPYSVEIKNT-CTSVYTKDRAAKKIPALDILLIKLQ	136
ESHARK	---REDVLLKLSVVERI-GEAVGRYACIKGT-CVVVYTKKAAKKAALDILLITLLH	140
LIMPET	---KYGLLELSDFIHKV-GKKALPYLVEIKEA-SLSNYMTRDPTKIKSSALPVLIKVLE	135
LINGULA	---KTAILETLCLFMERA-EKKVLPYAVDIKDV-CITLFIREEKAAVKVVIPVLIKLE	134
TRICHOPLAX	---KEDLLKLTAYMEKI-GGKISPYAVQIKDV-CISLFTDRKAAARVNATFPPLQLLS	132
STONYCORAL	---KIELLFLQSYVMKM-GKKINPYVVEIKDI-CLKIFSQDHSNKAKAETLPLMAEILD	132
STARFISH	---KEQLLEFLHAFLLKA-GSRLARTVEIKKI-CISAFMRDKSAKVKTKTFPVLIELLQ	134
LANCELET	---KVETLSFLAFLEKI-GRKIQHAVVKEV-CMAVFSRDRLSRVKATFPVLKVLQ	135
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Supplementary Figure 4: CLUSTAL All phyla small

APHANOMYCESE	HYA-----PPSASFQLPRLIGRLLDELKS---SKTQTQVKGVILELLGALLQKYPQ	200
FLATWORM	HAV-----GS-SVDGNQLNVGQLCERLRLEVGQ---RQTSEGVTOGLYRALGSIICKHYPE	176
STYLOMCHIA	TFN-----SK--EIEEMIRPNDMMVLLDEIK---LRKPSATVKGTIWTLIGLLHEKYEQ	178
TRICHINELLA	ECIKYSSVSTSEELNFCYDELHLCCLALIDSL--KKLQNGVKKGLFIIIGSLCQEIPE	189
HETEROSTELIUM	MKL-----TD-NINPEVFGVREMSDLLLQFT---CGKLTQTVKAELLETVGLFTEYFTG	218
GLOMUS	SSK-----RI--IDPEKLNVRDIISRYLEIFFVVRTKGTSGVKAKAGALDMLGIIAHRFPE	194
MOSS	LNM-----AR--LKPAMFVVDQELSTLLMFEFRK--AKTNSTLKNANIIQLGLDLIEYFRE	186
TERMITE	NG-----PWNDNLNVDELFDKLNPFKSNKSNMTPAKVVQKHLHLGLIIVHKYPE	183
SALPINGOECA	HEQLFTDENR-GQLLRELKADLLKKYLDPFHSS--ASKLTQTVKRDMHLAIGLIIISLSPA	192
ROTIFER	LTk-----GE-YEITAKMNIKPLADDYFLSLANQ--SKLSSSIKANILSILGRICWYHPE	180
SHRIMP	CCG-----SH--IDIQEIINVDFIERLCIDIR---SARGSTVLQHQLQTLGMLMYSYPQ	185
SCORPION	LCS-----GA--ISSEQFNLOKIVNKIIEYLAQA--SSKITPTVKQAYYLLGIISSRHPD	187
SPONGE	LCG-----KT--EYSHDLIPKIIADKFFQAALLP--TKHSATIRGGIYHLLGLVCEWFP	179
HUMAN	TFR-----SS--RLMDEFKIGELFSKFYGEALK--KKIPDTVLEKVVYELGLLGEVHPS	187
ESHARK	SKL-----SS--SCLQQFKIGELFNKFGDLSQK--SKFPDTVLEKVVYELGLVLAEVQPT	191
LIMPET	LSV-----GS--NMGEDLKIQKFIKFFMELTKA--SKLTATVKGKIYYMLGVICEIYPE	186
LINGULA	LTE-----GS--QMSEELNMREIELFFMELSRK--TKHQASVKRELYKLGLIFAEVYPE	185
TRICHOPLAX	SKL-----HS--SVVEELAISKLVDKYSACKQP--TKYSSTVKSGMYSLGTTIAEKFFE	183
STONYCORAL	VKL-----ES--SVVEKLDVPKIFDKYFGACIQP--VKHSSTVKYWLFSLLGTIAKVPPE	183
STARFISH	RSA-----SA--QMEADLIPKMIELYFQQLMQP--SKLSQTVKQGIYCLGLVLAIEYVP	185
LANCELET	LTI-----HS--QLGDELRVSDMVDMPFLELTMK--SQTATVKSAGLSLGLVISEVYPD	186
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APHANOMYCESE	EMDS--SRENI--RSWIEAAL-----DKQF--ASNSPELQIINGSFTECLAEIITANTY	247
FLATWORM	EFQP--VAVKI--SVNVVKS-----VQKI--KSDHTKVQFAVIASLFEFLSNYFCHFSL	225
STYLOMCHIA	LNDFKVESQD---VGFQEL-----VAQM---KSEKPEIKAIIGMLKGFTHSLVGECT	224
TRICHINELLA	KLITADYNYALLFANIMSEEL-----KNQMC--SSIHSPSYSVIEGCFGLNDLLAHFSN	242
HETEROSTELIUM	IMFD--KSAQL--ISIFMETL-----GSQL---KSKTPETFLIKSSLLGLNSLNLNFS	265
GLOMUS	YVDF--EKNKI--LRVFLANL-----KEK-----SLTDAAFTEGLYSFLFAYSD	233
MOSS	SFEE--ENVLAI--LKLCLDPTL-----EQQL---QKSPQLVLMAGAIKCLDSLLMWFND	233
TERMITE	CLRP--EETRL--LRIYSEL-----EMQT--SHATAVKYQIIAGCLNGLTEFLYVFP	232
SALPINGOECA	FAAS--SLSTSV--LNVYSEL-----RQMT--GKAPPELPTVEGCFRGLTAYLKTNPV	241
ROTIFER	VISS--KSNKC--LELFLTTL-----KNEIN--AKFRKSDLIAGALDGLNSYLNNSV	229
SHRIMP	NLRH--QSPLI--LKIIFKQL-----VKHTGSKPDLNALAGVLRGLALYLHHPPE	231
SCORPION	CMQL--CSERL--LNWYKDL-----KFHT--TSNQSESSIIVGCLQGLNEFMYPQFL	235
SPONGE	HLVK--ISSRL--IDIYMSNL-----KSEMTVKKTKKPELPIISGCLYGLTAYLNNFSQ	229
HUMAN	EMIN--NAENL--FRAFLGEL-----KTQMT--SAVREPKLPVLAGCLKGLSSLLCNFTK	236
ESHARK	EMLH--NSEKL--FCAYLNEL-----RVQMT--SATREPKFLVVSGLRGLTALMINFTK	240
LIMPET	YMTT--DSTKL--LDIYKSSL-----KSQMM--SKTNKPEMTIISGCLBGLTSLVNVFTQ	235
LINGULA	GMVN--YAERL--TDLCVRTL-----QAEMN--KKTGKPEIPVMTGCEALSSILTNFTQ	234
TRICHOPLAX	YIMP--HAQQL--LTIYLNLT-----KSQMT--GKNTKLDMPVIYGLRGLTSLYLNFTQ	232
STONYCORAL	CVIS--HSDHL--VKHYVSVLKLLENLIPQMT--RKTKKPDMLIAGCLRGLTSLYLNFTQ	238
STARFISH	LMSG--YSERL--LSVYIATL-----NQQMT--SKTRKPELTVIAGCLTGLGHYLVNFTQ	234
LANCELET	LMVQKDHDPRL--LKVYISML-----KEQME--SRTRKPEMLVISGCLBGLTHFLVNVFTQ	237
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APHANOMYCESE	D--EG-----FRDKLFKYMHVTL--ATATSGNLSRLAIVKSCLLLLGRHIQVFSENIVRSD	299
FLATWORM	E---EPD---LKVYHLAVKVI--AGK---NYQRYEAPKQALLLFANHCVPVFAFLADN	273
STYLOMCHIA	L---DQD---QLDALYVCLKTAI--QPIL--DMQHKGVMKSAMKLLGTHINLFKKHVTRH	274
TRICHINELLA	LFDGACR--MSCSELFNLIKAC--NPKN--DVHRLGHLKAALSFLISRQVQFRHHFLDE	296
HETEROSTELIUM	DFISGSS--KNVQLLYQYLYICL--DPVS--SSQRFDIPRAAMMVQRHTSLFKQYLTEQ	319
GLOMUS	SIKKENQ---DAYIFKCIIMNSI--TMVE--NDRYYSIVKTGLQYIIDHSNIFGEFFLRE	285
MOSS	SLPAGGS--VENSRRVFTCIEQVL--WPRE--ELKRYEPLKASLRLLSRHAGLFRMLIES	288
TERMITE	KPQEK----EARRIYDCVTAVA--RKH---KEMRVAPRCALGLIQAHGGLAKFLYDE	281
SALPINGOECA	SCDPSARQATPGVQIYNYVKMAI--NPDVTVKMTFRQVPRAAALDLFALHADQFRSMIATD	299
ROTIFER	S---ETSD---HLRAVFNFIKLSLSSSE--DLSRYAVPKSALNLIKHCRCQFDELIYSD	281
SHRIMP	GIDDDPQ---LFTELYKHIIHKVL--NPDL--NLPRRDAQRAALELIHTHGAKFSSQLFED	284
SCORPION	QDTEDE---KAYQLFKFIRIIL--SKR---DVKTYDMAKASLTLSSHASLALQFLYED	287
SPONGE	SASEGSV---YAQDIYKYTRMAI--DPLA--NLTRYEVPRAGLSLISRHAQFREYLVKD	282
HUMAN	SMEEDPQ---TSRETFNFVLKAI--RPQI--DLKRYAVPSAGLRFLFALHASQFSTCLLDN	289
ESHARK	SMEEDPK---ASKDIFDYALKAI--NPQI--DLKRYAVPLAGLRFLTLHSSQFGTCLMDN	293
LIMPET	QSGD--D---SCYDIYKYCKMAL--KQST--TLTRYEVKAGLHLLSKHASQFNEFLIDD	286
LINGULA	SAEAG--K---HSYDIFKCTRMAL--NLE---ETARYDLTRAAALTLKRHASQFSQFIYEN	285
TRICHOPLAX	SVEESK---YAADIKYARLAI--DPKV--ELPRYDLPKAGLNLIAKHAQAFCDYISRE	285
STONYCORAL	SVSEGSK---FAKDIYTYGRMAI--NPQV--SLSRYEVPKAGLYLFAKHSQAQFKEYIAKD	291
STARFISH	SVEEGAK---HSKDIYRFARMAI--DPTV--DHTRYELNKAGLNMFAKHSQAQFGPYLYSD	287
LANCELET	SVEEGSA---HSKDIYNFTRRAV--SPQV--EMARYDVPKAAALWLLAKHAQAQFNEYLMDN	290
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Supplementary Figure 4: CLUSTAL All phyla small

APHANOMYCESE	TYQFYSMFLFCCTSSNKKVRKPAFSCLDGAFDIAQGLVCDVA-----QNKHFNF	353
FLATWORM	YEVLFEQFFRWSTHHRDLMLHVGLMAFDVFKVSVSTAATSAAESAATPAQKKLFLF	333
STYLOMCHIA	AIELVALTLKLCVNEHMETRDAANEMLVHIMQEISDGIIDSS-----IHDDIFR	328
TRICHINELLA	YSLNECFSHWAKHYDREIKTYSLNAEDLLIRELATELITKVDS-D-PNHVRSVYKY	354
HETEROSTELIUM	SEKFFARLEEWCKHINKKNRDLAFNTIDSFLQQLANELTVGNR--S-IESDQATFKY	376
GLOMUS	YKEIWQCLWKLVRHNRPEVRNAAFKAIWAFKQIAKVLNSATEF-----KEFDCVDY	340
MOSS	GIRNMHWLQEHCTHSNAKIRDAALPAYDQFITHVSSALVSDS---R-IRNAQALYTA	344
TERMITE	YKFWHEFLKWINSAAGE-DHKAGVVALDVFNQVASILKDNTE-----SETGHHVFLY	335
SALPINGOECA	FELLQYLSDSCEHNNKDIKASAFRALEAFLQQSVAHMTKAG---K-SKDTMFMFGT	355
ROTIFER	YKEIFDRISQWSEHKNYDMKKLALYALDSYKSLAEMIRVKSNTET-DKCR-LIFKY	339
SHRIMP	CTQVQWVFKWCGSRNRDDHKAALPAMDTFIVVIANMLELQAM-ED-DKRGVKIFKY	342
SCORPION	SMNIYKIIIEIWTNHSNREVRSLGYNALDAVFKQISDMLEQNY---E-DCKAEIFK	343
SPONGE	SEHMYESLSSWSNHKNKCEKRVAVNAIGSFFREVTQISDPSI--S-RELGISNYK	339
HUMAN	YVSLFEVLLKWCAGHTNVELKKAALSALLESFLKQVSNMVAKNAE-----MHK	343
ESHARK	YRTVFEKMKKSCGHTNSEMKKASYSALESFLKQVAIQVAENAH-----LHKD	347
LIMPET	YEDMYDRLYFWSHHNRDLILHVGCMAMESFLKEVNMSYLSFG-----DSVFF	336
LINGULA	HERLYSVLLAWSQHNNKDVSSLGMEALEAFFKQMAEMLATKAE---E-GHPDRAAF	342
TRICHOPLAX	AEALYEVIRWCRHRNRDIRAAAFHALELIMKQIAEYLVNE---N-DAANINIFK	340
STONYCORAL	YEVMYGDLYRWCKHHNKETSAAAYAAEAFFQQISLYFVGRH---G-DKSDLAMF	347
STARFISH	HQDLHEAFNKWSAHNPAVKAVGFAAQEAFLQQIAEILVERAAK-R-DASDMAVFR	345
LANCELET	YEDMYRKLIEYWSQHPNRDLKQAGYAALESFLKQISDMLVARHEKEN-NKADLAV	349
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APHANOMYCESE	EFLSCLT-----EK--MSDDKVSIALAGLSFAAIIPVFMGDGALSKIHTRL	398
FLATWORM	QFRQILD-----SD-GSSWKTVSVAVRGGYFAEAACKLLAPPDMRQVYADV	379
STYLOMCHIA	EFETILN-----NETNQTNVLLISTIKAVGIFSKAIKTKSGDDALREYLSKL	375
TRICHINELLA	QFDEIFS-----NT--SGIREISMISKSYGRLFQIGKALYGEVECKVLRKL	399
HETEROSTELIUM	KFYSIFE-----NN-NSTPFDISIAIRGCGRFAAPVKAFIGEWELSKLLGSL	422
GLOMUS	IFDDIAGEIKKTSDOQLNKEEQ-DQKTKDISIAVRGGYFACSVKRLDKEERYKPI	399
MOSS	DALDVLN-----AQ-DADPKRISLAIRALGKLAACIVKFSKESLKDAPHRL	390
TERMITE	FFKNKML-----SS-STSSYDMKLVIKAFGLFAAPCRVYMTPODVLVMFTVV	381
SALPINGOECA	RFKAAMG-----EA--ASHRAVAIAIRGYGLAAPCKLLCGVDDLRLMSDDL	400
ROTIFER	KFYKNLT-----DG-NKDLKEMVISIKGYGAFAGPCRELMDTKDMKMLNII	385
SHRIMP	EYNKMLE-----TS-E-STSKLSLAVKGYGLLSGACRQFLSPVEVHTMFSQV	387
SCORPION	KFQLMIK-----CS--ENIRRVSTAIRGGYFAKVCKLYLTEKDVKYMLNDV	388
SPONGE	CFRSLMN-----DP-DINHRLLSIAVKGYGHFAKPCRLYGSMEDLHFMFGEM	385
HUMAN	QFYGIIR-----NV-DSNNKELSAIRGYGLFAGPCKV-INAKDVDFMYVEL	388
ESHARK	QFYDIIR-----TP-ESSMKELSAIRGYGLFAAPCKA-VNSNDVDFMYIEL	392
LIMPET	QFRQIMN-----SS-ESSDKVSLAIKGYGLLAGPCRRFLNVTDVVFMLESEM	382
LINGULA	KFREITD-----NP-HAKQNEIASAVKGYGAFAPCKFHMTAEDVKYMFNEM	388
TRICHOPLAX	QFRSIIID-----SG-SSDAKELAIIRGYGFAAPCKTLLKDDVRFMTMDL	386
STONYCORAL	TFRRIID-----SV-LSDTRQMAIAVRGYGYFSKPKCLFMQADDVRFMFSEI	393
STARFISH	RFRDIID-----NP-QSDTRALSSAVRGGYFAAPCKLFMTDDDVKFMFTESEM	391
LANCELET	EFRTIID-----TT-EAGTREMSIAVRGYGFAAPCKMFLSESDVKFMFSEM	395
	. * :	
APHANOMYCESE	VKYGEDVMMAMREMK-----FKWMLLCRFTTCYGHFVRNMQSNEA-AVENF	443
FLATWORM	VQRAEDLFTAESDSS-----DERLSNLPFVSELSNLALHLDLDELGT-VFLSL	425
STYLOMCHIA	TTLNQNKIIKEFEQQEDPKNDYKNFKQILKKQQLLSFIESYSFIIQNLDSEPSDEV	435
TRICHINELLA	LQRFYLYSTTSSDAQ-----QQNVYHITNILEAASRGLLCLSKIAD-DVWQL	445
HETEROSTELIUM	FKFSEKLMVVKLENI-----DEIVMHLSSFINAFSNILFEIKDIEY-WYMEH	468
GLOMUS	LNPNSNWAISNLNEIE-----ITHALSQIPLYIEAYCFIGREYDEIFQ-QLMET	446
MOSS	EPFGSLRSL--GDGR-----EGSLGYAVTLVGAFAADMVIHLDDVED-LMVTF	434
TERMITE	MQRABEQIYFKEGDIS-----NADLQNLDPYIESLSSIMRQLSAVTN-EQLVA	427
SALPINGOECA	ARRCQQLYFHMGGDE-----QEESAHLASYIDAIARLIQQLEESGD-VFLPI	447
ROTIFER	IDICDRNFLSADSQA-----HNEIYDEKIFQLSSFIESLSCVCSQIDSFSE-GSLNT	436
SHRIMP	LTASQHFYQSGDML-----ENKLTNLPYSIESLAIISNMDDVNS-GILEN	433
SCORPION	IKKSEQHCLNEEKIL-----DERIQILPSFLDSLSSIVLQLOEISE-SSLNY	434
SPONGE	VQRSEQLFLASVDFTTS-----SSSVAFEEFLLPTFIEALANISKEIQNLDP-VCLSS	438
HUMAN	IQRCKQMLTQTDTG-----DDRVMQPSFLQSVASVLLYLDTVPE-VYTPV	434
ESHARK	IQRCKQMYLTEADTE-----DDNVYQLPSFLDSIASVIFHLDKIPG-VYTPV	438
LIMPET	LNKCEQQFLKLVGEN-----QDKMYGLHSYLDIAIANIKEIDELSE-TYASI	428
LINGULA	MQRSEQIFFSKNELK-----VDNVYNLPFSIESLARIVEQMEVSD-TFLVS	434
TRICHOPLAX	LQRSEQLFFI--DVN-----VDKIYLPSPLEAFASILNILDDEVND-TFTRS	430
STONYCORAL	MQRSEQFYLSQSDLS-----EDRAQHLPTFLEALSSIEELDKISD-SVLAC	439
STARFISH	IQRSEQLYLQQGEVS-----DDKLNQLPNFLEALASIMRQLDVLSD-SFQAA	437
LANCELET	MQRSEQLYFGTADSM-----EDKVHHLPSFLEALASIVQHLQQLSD-MFVTS	441

Supplementary Figure 4: CLUSTAL All phyla small

APHANOMYCESE	AVTLACRILEAYPSSAIYVKYQAEISLVSIFQALPTG-----NAIDRVIRHGILLTVST	497
FLATWORM	LARLSVTVCHMYPRVSRMGRVGLRAVAHALHRLRSRRPGLAKAFAAQVYVQSLVRTCSH	485
STYLONCHIA	FLKVCIEIGVRHHRKLYQKYRDRFYEALASFTKALSKH-QKAFANWIKQFVDLSLIQTLKI	494
TRICHINELLA	VERFHVTLFHNFPLEMKRFYHRCKVINAVTFAAAYGH----NYQYIQSIVFQSLIRVIAS	501
HETEROSTELIUM	LEQAVATYFIIFPYLFTVQRERYSAVNRLLSSLYHR-PEFLKTLGRIVRQGLLITFSK	527
GLOMUS	IEHEVGLMMIYFPRMVYDLRLRCVNAFEHLLWMLYLKGRGTMEKRFVSKSFYQTLILTCS	506
MOSS	IAQVTGSIFFLYPQLFAKQKQAVYTALRNLLKALYPK-GPVYFFLRNIVWSSLQRAME-	492
TERMITE	LQCLTVQLIENFPKLPKPFHWLAIRAITVTLSSLAESGGTFLEEFLSNVVYQGIIRSKH	487
SALPINGOECA	LERLIVLLEAYPSMYRTQRASVHLSLTRCFVSLYHK-GSTLQTFFAKVANHVFLSACSQ	506
ROTIFER	MEKLVILAIIDCYPKLVKRYNNQISLAIAALFLAIQR--TNFSDEFISRIIYHSLIRIFSY	494
SHRIMP	VQQLSSALVEHFPVLSVSPKRFVLAIRALFRLLFTVYNK-PGYFHEFLHTFVYKAIIVLSCSH	492
SCORPION	LEKLAVFQIQNFPYLPSPYHFLCYNLSIKFLAVHVK-GPQFKGFLNKIIYQGIIRTC	493
SPONGE	LQKLSVLLFHCYFPLSSHVRYQGSVSLKLIMAVSSI-PTSFKQFLSHIVYQGVIRSCS	497
HUMAN	LEHLVVMQIDSFPQYSPKMQLVCCRAIVKFLALAAK-GPVLNRCISTVVHQGLIRICS	493
ESHARK	LERLLVVQIDSFPLYARMQPICCRSIVKVFVALAGK-GPVLWNFISTVVHQGLIRVCSK	497
LIMPET	VEHLLVMQIQNMPMLNEKMHFMATKSVIHVLLALMCK-GSVFNQVLSGVVYQSVIRTCSH	487
LINGULA	LEKLVVCLTEHFPSLYKRRKLDVQVSLGIFHALISK-GPTLRIFLGRVYVQGLIRTC	493
TRICHOPLAX	LEKLTIVLFENFPYVINELHSLCYKSLFELLALHLSK-GAALKNFLSRVYVQGLIRTC	489
STONYCORAL	MERIVRVLPDKFALNKGKFLCCKALIRVFLHLSK-GAILRNFLSEIVYQGLIRTC	498
STARFISH	LERLVVVQVSSYPRVFNKYQLSHQAILLVLIALLSSK-GATLKNFLSRVYVQALVQTC	496
LANCELET	LERLVVVLFFENFRLGKMKMLICQKAILKVLVLLVLPK-GATLRTFLSRIVYQALVIRTC	500
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APHANOMYCESE	QLNPSQEETLYH-----PDTGLPEPRLLFEYEILLWRNLLKRLKDKQK---	538
FLATWORM	EHVPYQSDTEAGSSPGSASDSAADPVQGDASNSVRKISYKDYLRLLWCLFSLKEK	542
STYLONCHIA	PDAVLFG-----GESPYESLQDAVQFWREWLNKDKIWS---	527
TRICHINELLA	LPSVGK-----ESIVLAKDENTFHLADYLPFWKMLLDSEFVDL---	539
HETEROSTELIUM	PHEALLPH-----LNTGDPWPYEVYKEVWYHLLHPKPSDISRG---	565
GLOMUS	AIQIQNRSDLQNA-----NSKDMIDVVAEHTYQEMFFWENIFKDSLWS---	551
MOSS	PVDE-----ALEEGSVQLWRHYVELWSHLIDFSSDQG---	524
TERMITE	QIAIDVELQKGQ-----FHENVFTYKDYIPLWKELLSVNNFQK---	525
SALPINGOECA	SIRDTEDMAEDA-----VAQSYLALLRQLLKGSGLVK---	538
ROTIFER	KTLYSVNQEDTSD-----ETNEPMSSIVTTSLDYVMLWSNFGLEQFSD---	539
SHRIMP	APEVSSPGEQGSW--RGKAG--GGEWVKGLKNEVVTFSYIPLWTALMVPEKVAN---	545
SCORPION	PVRFIEIAREENMS-----GDNLELKNPREITSKSYSLWENLLYIVRNKE---	539
SPONGE	PVVIEAVQGDSDAVV-----TAAPLADSNKVMYSLDYVQLWIQLIDYKLLKG---	545
HUMAN	PVQLPKGPESESE-----DHR--ASGEVRTGKWKVPTYKDYVDLFRHLLSSDQMD---	542
ESHARK	PVLLPGEGTGRSESG--LQQQS--ASEVMWTGKWRVPSYKDYLDLFRSLNCGMKME---	550
LIMPET	PIVLETEQTDDDTLY-----NVDVEKQISYKSYLNIWNLLMDSPEIKV---	531
LINGULA	PVATDLGEVEAE-----VDMEMQMESEKKITYKDHLDFWNMLLGGSSHLKV---	538
TRICHOPLAX	PVYVETSDSLNI-----SQDSVILETGPRISSYKDYISLWKNLIQATEIKG---	534
STONYCORAL	PVILKEVNGESTIMEER-----EVYEGSTPNTSLKDYLELWWEYLLDKDKLKD---	545
STARFISH	PVVLGDGSPSIDH--PVLGNDQ--DTEADILADARHITYKDYVKLWASLLDSTHVKE---	549
LANCELET	PNVIEGVTAEDDELPAVSGEG--GEQQPQPPVKRFSYRDYLELWGNLLDSSRLKE---	555
.		
APHANOMYCESE	-----NHGKIIDVFMKSILEVFE	556
FLATWORM	-----LCDYV-----GMSAA-----EARSISGGIFDAFLSSVLAIE	574
STYLONCHIA	-----EYTCQYVYGELIQRVIRIIS	547
TRICHINELLA	-----SEFG-----FDRA-----MQVNIQRTLDFCFMKSFLIIVR	569
HETEROSTELIUM	IQMEVEQHVVQVQKQEEGEKEKEKED--SISIS--TSEDIQLLYNEIVQTMITFIR	619
GLOMUS	-----IIDQSGFL-----IDENRLNTIQLEFFSILYDEFISSVFKMIR	589
MOSS	-----LQLEAGLDEAESFEELVTSDVGNVGIIESSLRESIYDAIMHCYIKVMN	572
TERMITE	-----RST-----SLT-----QTQLIVVKVYDKLVNTVVLVLMK	553
SALPINGOECA	-----IPDEE-----MTHE-----DRNAMLRTLYDETLLKAFLLHIN	569
ROTIFER	-----LKSDN-----LD-----DKKKIVEIIFNEYIESIIKIMN	568
SHRIMP	-----IKVSG-----MPAT-----VMTEMSNFYSEFISCIIEISE	576
SCORPION	-----LNHIG-----ISLE-----DRHNLQLIYDEIISVVLTLLK	570
SPONGE	-----MGM-D-----FDLE-----LRQSIHQLVYSEFIQSLNLIR	575
HUMAN	-----SILAD-----EAFFSVNSSESLENLHLLYDEFVKSVLKIVE	577
ESHARK	-----FGLVD-----TLQMINLPLQSLNRLLYDEFIKSILKIE	584
LIMPET	-----VLFES-----FALF-----ILTQLTDALYNELMNSVIKVLN	562
LINGULA	-----HSKLT-----PD-----EKSALTQAIYDELVRSTLKIIS	567
TRICHOPLAX	-----LTLIT-----TDRE-----HIIVYQRSLYNELLHSLQRIIL	565
STONYCORAL	-----ESLLG-----KQLE-----ERKVMHGLVYDEMIRGILRIIH	576
STARFISH	-----VQAMG-----MNYA-----DRRKIHIILYDELIFSILKIIS	580
LANCELET	-----LSQWG-----VAVA-----DRQAMHRMLYDELVTSVLKVID	586
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Supplementary Figure 4: CLUSTAL All phyla small

APHANOMYCESE	RLDLRYKQKENKTE---ED-----	572
FLATWORM	RLDLSACRLSDLEPPVTAASEA-----SSS-----SATTDEDSAAPI	611
STYLONCHIA	DLNLTYYKVEKGRNNKDGNOQE-----SNNNNNGRDPQILNQEL-----TGLH	590
TRICHINELLA	L LS FPETKAFQDVEE-----Y-----TFRF	588
HETEROSTELIUM	KLDLSYSTKEEEEEQEKEKELKKQVVKDKDKGGEEEEEEEQQEEDVTMEDQQQDGLF	679
GLOMUS	TLNLA V TEASDVSL-----GTSITKNN D HEVDA-NLI-----AIAG	624
MOSS	ELN L KYRVKPARTGKYSEE-----L-----DAGP	596
TERMITE	KLDLSTRKKTNIEAL---STSG-----G-----ASEA-----DIPV	581
SALPINGOECA	KLNL T THSSSDAE---DEDVAV-----ATSGVK-----EEEPHE-----VDDV	604
ROTIFER	KLDLAAVKN D GSEVN-----GGEQ---ENVDKNQSD-----LGVS	600
SHRIMP	KLDL T TYKQNELQ---QEEVS-----G-----SDEG-----DPAT	604
SCORPION	KLDL A TTHSMQDSEIKDSNLK-----G-----QFETSEL-----YSTV	602
SPONGE	KL D FTTASTTEDGIMANE G EGG-----GGSGGG-----D-----PVIT	608
HUMAN	KLDLTLEIQTVGE---QENGD-----EAPGVW-----MIPT	605
ESHARK	KLDL S VEKQ N QRE---EEGSG-----DVSNGN-----VIPT	612
LIMPET	KLDL T STTSTELT---EQMDEA-----STSGGD-----VTMET-----DDVS	596
LINGULA	KLDL T SVRGS E DT---DQGDSA-----GTADKG---RP---VTP-----FLAS	601
TRICHOPLAX	KLDL T SSQQTIE---EETQ-----S-----SEGT	587
STONYCORAL	KLDL S SSK G SSAQ---EGDILG-----KSSASD---VPASATADK-----EVSL	614
STARFISH	KLDL T TSNKDTTEL---QDQVA-----VD-SDST-----EDAS	608
LANCELET	KLDL T TSKQVETG---NEELT-----ADVSGSQ-----DGT	615
	*.:	
APHANOMYCESE	---ASEFEPLIS---RDQ T IALN L TEFCERWLPSVQSS-IQPWIPFLKWI F SRSRESPL	625
FLATWORM	TD T LQGMVASTP---KDIVIFVNLV D FVEELLQHHRAGPIAKWFYPLCQALI E KSAENPL	668
STYLONCHIA	QDYIVQYIANN---TDQ Q FLVRLSNFAEMFLLQCKDQWFLKWI P QFTDTL I KKASQTPR	647
TRICHINELLA	GNPVFNVIPTKQ---ADYDLFYNLVE L CRSVIMNGSHVLFEPWLQ P M L TMLLE S SRYPM	645
HETEROSTELIUM	NIGEDTLK P STP---KDI E FLN L VEFSK L FLARQHTN L LTRWIYIFGKEI I FGSRKYPL	736
GLOMUS	SGDLET L QPLVS---KDFVLFQNLV D FWQLFLPRIKSELFSRWVYLAGDTLIT F STRYPY	681
MOSS	IEPEAEMDLIEPLDMI H MRKYLN L VDFVQELLSGPCSS L ILKWTY P FGRCI I E L SNRYPL	656
TERMITE	LDPE S GLEANNR---KDFQVFINLVDL T RDV L MSVDCS Q FEKWI Q PPFYKVI S ESSNKPL	638
SALPINGOECA	SDPT T SLIASRP---KDIQVLIHLV T FGQDLFSTR T DLFPRWLHIYSDI V TRSSKYPL	661
ROTIFER	SDPIIGLKPQK---RDFE I FINLVD F TRELLMKN N FDLFEKWL F KLSKEI L LSTSHCL	657
SHRIMP	SDPV S GLKAKVP---KDFQVYMN V S L LEKVLPLQ S EDQLEPHI P RLVWF F V T QSS L QPL	661
SCORPION	SDP F YGLQ L SKP---KDFR V FMNI V DFC K DLFIS K HNELFEK W ILIFGL E IIQ F INKN P Y	659
SPONGE	SDPV L GRQPAVP---KDFQIFINLVE L LAKKVI P SVLSL F TPWIL T FSQ E VVSLATRYPL	665
HUMAN	SDPAANLHPAKP---KDFSAFINLVEFCREILPEKQAEFFEPWVYSFSYELILQSTRLPL	662
ESHARK	SDPAADLQPVKP---KDFAFVNLVQ F STELLERHEEF F DQWVYRFGYELILRSTQFPL	669
LIMPET	ADPT S SVHASKP---KDFQVFINLVD F CRELLPNKHINL F ENWIF T FSHN I L L STQ N PL	653
LINGULA	SDPV S GLQASKP---KDFQVFINLVD F SRDLHTDQYCALFKRWV T FGHLIVMSTKYPL	658
TRICHOPLAX	SNPVAGLKNVP---KDFQVFINI V DF T KALLP T TRTE F FLPWIF P FGKNLVLLSTRLPL	644
STONYCORAL	SDPV P GLQPKVP---KDFLIFIS L IEFCRCVLPNYCV T FERW I YMFC R DI I MSSR F PV	671
STARFISH	SDPLHGLHATKP---KDFQIFVNLV D FCRDLLPANQPALFKQWVYRFGHEVILLSCRLPL	665
LANCELET	SDPFAGLQAAPK---RDFVVFINVVD F CRDLLPHHHP E Y F QRWVFTVGHALILHSTRLPL	672
	. : :	
APHANOMYCESE	VSVLYRLATVVSRI L AIE---VSI-----	646
FLATWORM	ISGFYKLLATFVTRARDAGYFNDQ P V P V V MEIAD T NTMESDNQDSQT---DNDEEGQSVV	725
STYLONCHIA	ISKLYQLLKVCMQICS N HRYFEVSD D IDS V -----A	678
TRICHINELLA	VSGFYKLLAVVVTMAEKLNYFN T EQDKTENC-----	677
HETEROSTELIUM	ISGFYKLLHVLLKVAKKVNYFG F IDG S NKSSLDANGGEDDSMEIDSGK----SSIPAD	791
GLOMUS	VSGFYKMLG S CLTVCESIKFFDGIKNVDNE-----NIMI Q DSQD---QLSTA	725
MOSS	ISGFYKLLTVNITIANREGFLSVAGEDSLDAD---GG---YMNLDKKRDSTTFAGTTGV	709
TERMITE	VSGFYKLLTVALQLCDRLHYFSDYGD M L-----N	667
SALPINGOECA	VSSLYKLLLELANTIATEQRYFEAASKTAETA A -----G	694
ROTIFER	ISGFYKLLATLIMKMAVKIGYFNKIDSIQ T NLN---TSSDSV M LIEDCD P DSMY S STI	714
SHRIMP	VSAHYNATTTVLTCSRQ T QFFSRK-----	685
SCORPION	ISGFYKLLITVCLTICKKTRYFQHVKKLKTKEE-----I-----SM	694
SPONGE	VSGFYKLLTVCLSICNKT H FFDVHDL S GQGTG---DD---DVAMET-----E	706
HUMAN	ISGFYKLLSITVRNAKKIKYFEGVSPKSLKHS-----P	695
ESHARK	VSGFYKLLSATMKI A KKIN Y FKGVSTNTWKQC-----H	702
LIMPET	VSGFYKLLALCMKISNKLAYFQVNES N -----E	681
LINGULA	VSGFYKLLAICMHATRKTAYFKDISLSRDQDG---GE---NSMI-----VEEK	700
TRICHOPLAX	VSGFYKLLLEICMTISSSLYFEDLNIE T VTKC---TI---NAAA-----EA	684
STONYCORAL	VSGFYKLLLEVCMKCEKLSFFKNIAEK P DLK---NE---NLNLEI-----V	712
STARFISH	VSGFYKLLTVCMNICTQIQFFKCIKPSDLSSQ---ED---SMDIDL---NFSSSSCV	714
LANCELET	VSGFYKLLSVCMTICTKVYFKDLDTKLLSFS---EE---SMDTEG---R-----D	714
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Supplementary Figure 4: CLUSTAL All phyla small

APHANOMYCESE	----PPAVQDEYIDFILGVVNAMKAYSNELLSVTSIFVLATPLSMV-----DVKMLI	694
FLATWORM	AMENRIQCCAMLGSAASLSARCGQLRGDLLAASLRFLLSLPAALLAV-----DRPDDAL	780
STYLONCHIA	KKGKQNTYNMLLTFFKELIGKQEEYQDELLSCLDLDLHVQVQILYRQDKKTDNVQNWK	738
TRICHINELLA	----NSHYKLLSDFIDHVLVESCRFQGEELLVSLRFLALPTCIVVE-----KLESIK	727
HETEROSTELIUM	ELENKRNCFKLFAKFLKEVEAASSTQYKDELLASVIQLLLSVPKQLV-----NIPVLI	843
GLOMUS	ASPTQRASYFLFIKFFDEVSARLPQYKDDLLASCLRLVLSIPRELI-----NIQNL	777
MOSS	LEEDRRRLCKELFRKYLQEVLVASRRYKLELLAACLRLCLSAPLLIV-----GIASII	761
TERMITE	QPTEQKASYSLLCRFLQELLIRLQYKNDLQVACLETVIAAPVALVVP-----LLPHAV	721
SALPINGOECA	NMLEVAATLELMSKFGKEVMVRSKQYKDELLSACLTFVLSLPLPVVVKR-----DFAVFF	748
ROTIFER	SEYERVNCFHLFKKYLLEVSIRMKQFKDELLVSCLEFFLSLPEFVII-----SMDHSF	768
SHRIMP	QDPEVETS IHLLMSYVRELLQRCRQYRDQLLASCLTLILHLPLCIVQE-----IFPQLV	739
SCORPION	SEKDCI AFELFAKFSREVVIIYLQQFKDELLASCIEVILSLPTEIVES-----EINILI	748
SPONGE	ERTRDQSCYFLFSSFIKEV VVQMQYKDDLLASCLHLILVLVPEKEMVVS-----DFKELI	760
HUMAN	EDPEKYSCFALFVKFGKEVAVKMKQYKDELLASCLTFLLSLPHNIEL-----DVRAYV	749
ESHARK	TDPEKACAFALFGKFGKEVTIRMKQYKDELLVSCLNFLVLSLPHDIIEI-----DIKAYI	756
LIMPET	QEKQKAVCYLLIKKFSKEVLVRMKQYQDDELLAACLTLILSLPKEIITE-----QMIDVV	735
LINGULA	IGTDRETAFLLSKFTKEVLVRIKQYKDDLLASCLSFILALPPELVIA-----DLPTIV	754
TRICHOPLAX	ESIDKYLCLLYYKFYKEVLVRLKQYKDDLHVSCLSLILALYQLIQD-----DMALII	738
STONYCORAL	DTSDCMKCFVLFHKFTKEIVVRMQYKDDLLFSCLLVVLSLPLELVTL-----DLVSSV	766
STARFISH	SASDRICFTLFAKFSKEVLVRLKQYKDDLLASCLLLVLSLPHIVQA-----EVAHLV	768
LANCELET	RPSEGOACFTLFRKFVKEVLVRLKQYKDDLLASCLLLVLSLPHQIVQS-----EISTLV	768
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APHANOMYCESE	PALKQALS LGTSHNDTAVAAVSALENWHQVQPN-----ALKQFYQELLPLFAPYLISTSNE	749
FLATWORM	AAVRRGLRLGRFWPPLLEAALAEERWTAASS----AGLSDRVAPVLAGLLAVLLSDGG	836
STYLONCHIA	VIMQKAI DLGRNNQLAWNSINMLEQWFNLLPM---NVTLDLYHDILPKLSDFLQVDDN	794
TRICHINELLA	EAIKSSLKLGLNLYPIACVCMDALEKWSAEFFPEDE--PQLDSFYTDLLPIFDDYLRCTSV	785
HETEROSTELIUM	PTLSTAFRLGLSYLKLGHVGLNTIEYWLSVLPE----EVDALHYA IILPALSDFYLISTT	898
GLOMUS	SPICIALKMGLSYQPLATIGINAIEKLVLDQGP---QDISKWLEQIILPLFNEYLLVKAD	833
MOSS	PSLRNALKIGLRYPPPLAEVAMDSLERWQAAFPE----QLQHWLPQIIPCLNDYLVVDEK	816
TERMITE	PAFEVIFRVGRSMLPLARLGLSALDKWYCTLPS----HLVTPPLMQVLPYLDPFRLRSQV	777
SALPINGOECA	PAVETALS LGLGFYPLADAGLSALETWLPPALA-----AGRPFQALMPLLDKYL SAAVA	802
ROTIFER	HCLNQALD LGVNYLKLAEADLNSLEYWLKNIPT---QLIKPYFPSILTKFENYLQASSN	824
SHRIMP	SPLQMALQLGVSYLPLAEVCILALQLWTKSLSQ---EILSEHMPHVLLPLLYLRSQET	795
SCORPION	PAVQISLQLGLSYLPLAMSCDLALETWLYSLPS---ELLKEHYCKLLPSLNDYFLASDN	804
SPONGE	PAIKLALRIGMGYLPLAKSVMEALEKWTLYIVESDKMDTLQCLVNEIILPLLDYLYKATSV	820
HUMAN	PALQMAFKLGLSYTPLAEVGLNALFEWSIYIDR---HVMQPYKDIILPCLDGYLKTSAL	805
ESHARK	PALQAAFKLGLSHTPLADAGLDALEDWSAHIPK---HI IQPHYKDIILPHLDGYLKTAAF	812
LIMPET	PAIQVALTLGLSYLPLAGIADALEYWCHNLPD---HIVKPHYSCILPYLDNYIRTVDK	791
LINGULA	PALKITFKLGLSYQPLAVEGMEAEFWRDSIPN---HLLQPHYQDILPCLDDDFLKLQSE	810
TRICHOPLAX	PAIKVSMNIGLSYLPLANAAIDALERWSSDLPO---NIGPYFSDILPCFDDYLYKSSAD	794
STONYCORAL	AALKLTFKLGLSYTPLAEAGLDALESWTALPA---DKLKPFLREILQCLDGYLTTLGD	822
STARFISH	PALQMTFQLGLSYLPLAETGLEALERWMLHLLP---DSLQPHLKVILPCLDGYLYRGTIT	824
LANCELET	PALQTTFRGLSYLPLAHAGLDALEWRWLLNLP---SALEPHFPHLIPYLDLYLQTAAD	824
	. : * : : : : : :	
APHANOMYCESE	G-----	750
FLATWORM	SGAGLTDAAEAE-----QRGGADRRSLARQSV--ARALR-SIEARRAKNYAA-GGG	885
STYLONCHIA	KKQKKNLNDAT-----GGDTYQYLEMLK-----S-GNE	820
TRICHINELLA	DETLVNNGFNY--NG-----EKSTFFNKKLQTVNSD-SENVL---VKADDNDSEE	830
HETEROSTELIUM	NTSSSNQESANS-----KTGMLMGRGAAPRMNTKSID-F---VD--PK-LLA	938
GLOMUS	SVDNSIKEFAQI-RNTQRNRNGFNKSLDQTRKERVKSKGQKSYKT-----VVGIGQLE	886
MOSS	ADVSEPGETSLVTEAVGTS-----APTISSMSRQGLAQ-----IKRARA-KDS	857
TERMITE	ASGQDVIIIEKELMVLGR-----RNRTNYSQNKKVARK-----KI-IEH	814
SALPINGOECA	ASDIDVEEEMKL-----LSRSITRKRQAA-----VV-AVD	832
ROTIFER	KSDLDSDEKVI---LL-----NLSHGKGRKKLPVKLFD-----KSS-----L	859
SHRIMP	GGEAEVHTRVITVKMA-----FARQRRKVDQKMK-----ES-KRV	830
SCORPION	ISLQPLK-NIHT-----FTKQSLVVKKLPLKISQ-----YKKIKQ-TDL	842
SPONGE	QLKEED-GG-----RGQYATKRYARMKVE-----KWSEGL-HQG	855
HUMAN	SDETKN--NWEV--SA-----LSRAAQKGFNKVVVKHLK-----KTKNL-SSN	843
ESHARK	N-EAQN--NWEV--MN-----INNPSRKGGSKVLFHHTK-----KSKEF-LVS	849
LIMPET	GMVAFSI-----FMWY-----IS-----CGMHIRFSLLSFSSSF--STINCLLY-FQS	832
LINGULA	QAGNET-NSPSTLI-ME-----PKGHSYSRKKGLPIKLLK-----PAVAK---E	849
TRICHOPLAX	DTTETLVEDS-----SK-----ALKARTGKAKKLPVKVVN-----PT-GGS	829
STONYCORAL	IQLHNECN---TIVLIT-----SSHHTSRGRKLPKLLK-----MKPQSQ-HQM	862
STARFISH	QGSDAADVVQTVTMS-----ASSSQRAGKRKLPKAKLI-----GAS-TT-GQT	866
LANCELET	TGSSSSSDGFQTVSLT-----AASSTRGKRKIPVKLLK-----AAA-ER-NQV	865

Supplementary Figure 4: CLUSTAL All phyla small

APHANOMYCESE	-----LTVQLKLLKILGSMGGYSRYVQEEEDPQ-----L-----	781
FLATWORM	AELGLAEMQKRVLLFLGSAQSSFKYQLAEIASD-----KAATADLAAWSP	930
STYLONCHIA	VNIERKDIALKVMDDLKIGKIGNAHSIISNEQNK-----LIERENFIKWDP	865
TRICHINELLA	EMPNPQSVLRRIASFVGSGLCYMNRFLIDSADV-----GSLLRWQ	871
HETEROSTELIUM	QRTVVEEMQTRVIRILGKLGQNYHLMGVSNLM-----APGTESEGVAWDT	983
GLOMUS	KNVGLHDLQVRVLRLLGRLGGVSKFLFEDIVNNDLVYRPIPTMNPAGSKMSNNKLLAWDP	946
MOSS	QSPFELIQVRVQRFLLGCIIGGLGHFLVPEVDLL-----QLTGTGGLAWDP	902
TERMITE	PESELSQLQHEIISFLLGQLDSTTCLALLKDPQQ-----EEDVIPWAT	856
SALPINGOECA	SDNPFPAALKMRILRLGAMGGQNNHLELALEHQGAG-----GGSDVGEGETPPWVAWDM	886
ROTIFER	NFDVYEIQILKILKILGQLSADMSSHVHL-IDN-----EDITSDWT	899
SHRIMP	EETAMQKIQLMILRLIGSLDPLRLHTIP-QDP-----DTIASAAVRWNV	874
SCORPION	HESELIKVQHRILRFLGSGVGNQYNFAMIS-ADK-----IKIHEVAVAWDI	886
SPONGE	SRDDITSVRRRILLLLGLSGGVNNESSLKVPSP-----HSLVSWDS	896
HUMAN	EAISLEEIRIRVVQMLGSLGGQINKNLLTVTSS-----DEMMSKYVAWDR	888
ESHARK	EDSAITAVRRRIVRLGSLGGQNNRSLVTAVSA-----EEMMKRCIAWVT	894
LIMPET	YESKLGVIKDRVVQYGLSGGGSINYTLTNT-NSQ-----DDISKQAIWDT	876
LINGULA	ESSQLELLKQRIVKFLGNLGGATNAAMVQ-CTS-----EDIAKTAVAWDQ	893
TRICHOPLAX	KDSPLAQVRLRIVQLLGRGLGNTNSLVR-KGN-----DDGSSQAVAWDN	873
STONYCORAL	TLTPLAKVRHKILRMFGGLGGETNILLDDNTGI-----N--SSNAVWDT	905
STARFISH	QDSPLRVQLRILHLLGLSGGQTNAYLLE-TSA-----EEIAKVAVAWDT	910
LANCELET	QESDLVKARLRIVRFLGSLGGHTNACLVTGLTA-----EDLAKRAVWDT	910

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APHANOMYCESE	--SAPLDISLAMENVH-VEIPISNLIHQMKDLALTSIDRGIKSAAEGYHAMVLYLGGKT	838
FLATWORM	-GGRLLYFDLPFADSK-PRLYLDDPLSRCAVALATESSSRQSKVAAECLHSIVLLMTGRC	988
STYLONCHIA	--EKRLKFTVPLYTKK-VDIYFDACLPKVVDLAKNSSDRETRVAACEFLHALIYMIKGN	922
TRICHINELLA	--GSHLEFICPPDMK-FEIALDTPRLCDLALSAGDRPLKVAACEALHACVFLFLGNE	928
HETEROSTELIUM	--ISRIQLQIPLGDLNGVSIYLDVSLPVIVTLATRSTRQTKVVACELHHSIVLYMVGNT	1041
GLOMUS	--EKRVSNIPFPDTK-VEILFDEFLLPRIVELAESAPDRKTKIVACESLHSIVIMIGKS	1003
MOSS	--IDRVKFTLFRQDK-PDIWLDLSSLRMVEIALSSDRRMKVTASELLQAVCLLMLGNA	959
TERMITE	CLQQPLVFPPLPFKDMK-LNINLEKLIIPRVVELAMTSSDRYTRTFACELHGVMLILGSG	915
SALPINGOECA	--TNHLKFAVFPQEMK-PEVQLDPMPLPRIVELALHSGDRQTRTAAACELHSHAMVLYMGQ	943
ROTIFER	--VQHLKFYVFPFDIK-PTIYFDRFLPRVIHLAQNSPSRQTKINACELHSHALVIYTIKGS	956
SHRIMP	--QKLVKFAFPFEHIK-IDIYLDLPHVVDLAVNSSDRQTKVAASELHSHIILMIGTG	931
SCORPION	NKQNHKIFYLFPFDIVK-LEIFLDKFLPRIVTSTTASQRQTKVAACELLHSHAVVTFMVGCG	945
SPONGE	--DRRLGFVAVPFSDLK-PEIYLDPLPTCEALSSSDRQTKVAACEFLHSHAMLFVIGK	953
HUMAN	--EKRLSFVAVPFREMK-PVIFLDVFLPRVTEALATASDRQTKVAACELLHSHMVMFLGKA	945
ESHARK	--EKPLSFVAVPFMDMK-PIIYLDSPFIPRISELAALSASDRQTKVAACELLHSHVAVYTLGRC	951
LIMPET	--EQHLRFETPFIDMK-PIIYFDPFLPHVVELASTSSDRQTKVAACELLHSHLILYCLGRG	933
LINGULA	--EKHLKFDMPFMDVK-AALYLDLDFLPRVVELATLSSDRQTKVAACEFLHSHMVMLYMGKS	950
TRICHOPLAX	--HKRLPFAIPFQDMK-PIIHLDLDFLPRVVELATSSSDRQTKIAACELLHSHALVLYMIKGRG	930
STONYCORAL	--ENHLTFVAVPFQDMK-PSIYLDLDFLPRVVELAAKSSDRQTKVAACECLHSHLVHYMLGKS	962
STARFISH	--QPRLQFVAVPFVDMK-PNIDLDLDFLPRVVELALTSGDRQTKVAACECLHSHLVFMLGKG	967
LANCELET	--QTHLQFVAVPFMDMK-PTVLDLDFLPRICELATSSSDRQTKVAACELLHSHLVLYMVGQG	967

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APHANOMYCESE	ATLPRSKSS--ANEKSIYDHWANVFPVSLVMLASDADTITRSLFAPLLSQLLRWFSGISS	896
FLATWORM	AFASTSGND-----REQLTLWRLLPALPLADEDPVVKQLFQPLLMQLVHWFSSRSRE	1043
STYLONCHIA	ASAPKGRGNQQQEVAPFAKIYKLFPPVMIHLATEVENISRQLFEPLIFQIVRWFSSNSTV	982
TRICHINELLA	SFRTVKMKD-----RESISKAYSHLFPVLLKACDVEVPKQMFSTLQVILHLFSGTDF	983
HETEROSTELIUM	SG-----G-----SFHRLYRRVFPALLRLAVDVEVVARQLFSPPLIMQLVHWFTKNVR	1088
GLOMUS	AFQLSRQ-S-----QSPFYRIYKIFPALLRLAIDTDPVPRRIFRRLVAQLIHWYTNNAQ	1057
MOSS	AKGPMRRRGGED-SQSVHFDKIYKRLFPAILRLATDVELVTRQLFLDFVVKQLIHWFTSNQQ	1018
TERMITE	QEAQT--SH-----PDKYSELFRKLSLPLKLGCDPDPAPHRLYNLVQLVHWFSSKFK	968
SALPINGOECA	AGSGTHAAG-----EDNLSPLYRHVLPVLRACDVDLVPKQLFSPVLMQIHWFSSTRT	998
ROTIFER	VSEPEGYSQ-----SYQMTKIYHRLYPCFLGSCDTHDFVRNLFQPLVMQMIHWFTGNRK	1011
SHRIMP	AQKSQETQL-----KEPMAPLYRHIFSAMLRLACDPDHVTRQLFLTSLYQTIHWFTNNRN	986
SCORPION	AQQQPELQA-----IYSMKLYKNVLPALLQLACDVEVARKLFEPTFQLIHWFTTKRM	1000
SPONGE	TQQS--VQK-----KNPMTKLYQKLIIPVALQLACDVRVAEQFRPLVFMQIHWFTTRNTQ	1006
HUMAN	TQMPEGGQG-----APPMYQLYKRTFPVLLRLACDVDQVTRQLYEPLVMQIHWFTNNRK	1000
ESHARK	SQISEGQOE-----TLYKLNQLFPVLLRLGCDVDVTRQLFEPLVQLIHWFTSNRK	1004
LIMPET	AQQQPEVQK-----RYPMQLYKLFPPMLKACDVEQVAKQLFEPLTMQLIHWFTNNRM	988
LINGULA	VQQPEGQOG-----RHPLDGLYRNVFPAMQLACDVELVARQLFEPLTMQLIHWFTTRSKV	1005
TRICHOPLAX	AQQPGGTGS-----VTNYGNLYKIFPALLTLASDVEQVQSQQLFQPLVYQLIHWFTGNRN	985
STONYCORAL	VTQPQGF-K-----KSPMEHLWKHVFPPTLQLACDVEQVSEQLFKPLVQLIHWFTNNRK	1016
STARFISH	TQQPEQQA-----KSPMQHLYRNVFPALFRLSCDVEQVAKQLFEPLVQLIHWFTGNRK	1022
LANCELET	AQQPGEMQA-----KNPMTRLYKLVFPVLMQLACDVEQVAKQLFDPLMMQLIHWFTNNRK	1022

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Supplementary Figure 4: CLUSTAL All phyla small

APHANOMYCESE	MYPFEAQIFLDSLIDGISS--ADDGGAREVCALSSTFLKYASKQPGS-----TSF	945
FLATWORM	FEGPYTALLDLSLFDRLTASSGDASVRLDAAQSLREFLTWSVRQQMPSSGADSTASFYSR	1103
STYLONCHIA	YDHPVESLLEALIDGASS--RNNSASRDLCNSNAVAEFAKWSLKQMTDKNIK--E---NPN	1036
TRICHINELLA	ANKMVTSCLLDITLMDGLCC--FWNSSLRDQSAYYISEYCRWSMRKVDSGGQN-MR---SES	1038
HETEROSTELIUM	AENDETMALLNSI IDAVN--GEDGALREFGARALGEFASWSLKHAPTTKST-ANEARSFAF	1145
GLOMUS	YENQETMALLQCCLDIAICD-T-WGSLRDYGAECLEFLIWSIKQSSATHAE--E---SSM	1110
MOSS	KENPDTMALLDAILDGLVD--PDNGSLREFCADMFSEFLQWSVRHAPPEDD-----NFV	1070
TERMITE	LKSKEVEIILQITLMDGITH--PTDTALRDF SARCLHEFVWVSVKQG-----SHV	1015
SALPINGOECA	-EREVVLLDAILTGLAD--AKNSALRDFCATCVKEFYVWAYKHSTDKLLE--T---GG	1050
ROTIFER	YESDSTIQLLGCIMESLVD--EKNAALRDFSVNCKEFLKWSIKHTPLSKQE--NSAPTVP	1068
SHRIMP	FENVDTMVLLEALMEGIVT--ANDPALRDVSAQCLAEFVKWSRKQC--RQQN--S---VSS	1038
SCORPION	INSDETKQFVQVIWDGLVQ--SKDAVFRDF SARCLKEFVQWSIKQTSVREQE--E---NPI	1054
SPONGE	YESPDTVTLLEALELEGIEH--PTNASLRDFSAQCIKEFLVWSIKQTSKKQOE--R---SPM	1060
HUMAN	FESQDTVALLEAILDGIVD--PVDSTLRDFCGRCIREFLKWSIKQITPQQOE--K---SPV	1054
ESHARK	FESRDTVAMLEAILDGIVD--PVDSTLRDFCGQCVREFLKWSIKQTPPEQQA--K---SPA	1058
LIMPET	GESSETMALLDITIFDSIIQ--ADDTSLRDFSGKCLREFLHWSLKQSSVKTVE--K---SPV	1042
LINGULA	FENPETAAALLNAVMEGLID--PSNASLRDFCARCIEEFLKWKALQKTPSPAQLR--K---NPH	1059
TRICHOPLAX	YESVETIALLNALDGVIIH--STDSALRDFCAKSLREYLHWSIKQTTKKQOE--K---TSN	1039
STONYCORAL	YETPETMALLDAIVDGIHV--PVDTSLRDFSAQCIKEFLQWSIKQSSSEKQLE--K---SPI	1070
STARFISH	FESEETIALLNAMLDGVIIH--PTDTSLRDFSAACLKEFLKWSIKQTSKKQOE--K---SPI	1076
LANCELET	FESEETITLLDAIMDGLVH--PTDTALRDFSSRCVREFLQWSIKQTPPKQLE--K---SPI	1076
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APHANOMYCESE	SAHTLFRERL FALSSHVPVRSCLRGIALVNVQFYRDFREDQEMVDIYAISIQKYL LLAIKSE	1005
FLATWORM	NVKSIVKRVCLLALHPASSKRLGAALAFNAVYAQFREEDSLVNAFAFELLHCFMRSIQLA	1163
STYLONCHIA	NIKSLIRRIESNSNHPDPFKRLSSVLCFSKIFSVIREHDPLIDRFCMEIAHNVLGSLKMC	1096
TRICHINELLA	KVELLVQTIITFAVHSSAVKRAGAAVAFNNLYKIIREKRWLVDIYILEMFFTFMKSLYLA	1098
HETEROSTELIUM	NFKSLLKRVYSLAAHPSAQTRMGAAASLLSIRVMREDDNLISVFLFEIAHQVLLSMRLC	1205
GLOMUS	NMKSLLKRLYNLCAHPDYTKRLGASLAINIYRVFREEYLVDFQTFPELLYWMLVNLRLS	1170
MOSS	NVRSMLRRVYNRMAHPNPYHRLGAAMAHRMYPVLENGAIVDRYIFELFFCIKSLKLG	1130
TERMITE	NIKYVMKQIYSFCLHPCPSKRLGAALVLSVYTVLREEESVNVQFWLELLYHVMNLSLS	1075
SALPINGOECA	LKVLLKRI MSMAHPNAPQRMGAALAMNNIYTRLRESDTLVDVYVCELTDFVMSRLQLA	1110
ROTIFER	NAKSLIKRIFNFLTHPNANKRLGACLAWNSVYTFREEESIVNRHIFELFYLIESLAMS	1128
SHRIMP	NIKSLIKRIFSFCKHPSAFKRLGALAWNSIYREIREDDQAVDWTLLLAHLMTSLDLA	1098
SCORPION	GMNVVLNCLYNYSLHPNPYKRLGAALAFNSIYTFREEESLVDKFTLEI AVHFIESLATA	1114
SPONGE	NTKSLKRLYSMSGHPSTAKRLGAALAFNSIYTVLREEESLVDVFIEMLVVMVNSLKLA	1120
HUMAN	NTKSLFKRLYSLALHPNAPKRLGASLAFNNIYREFREEESLVEQVFFPALVIYMESLALA	1114
ESHARK	NTKSLFKRLYSLALHPNTPKRLGALAFNSLYREFRQESALVDQFIFEVLVVYVESLALA	1118
LIMPET	NASSILRRIFSFALHPSVFKRLGALAFNNIYQIFREEKSLVDRYTFQILVHFVESLSLA	1102
LINGULA	IPKSLFKRIYSFALHPSFPRLGALAFNHIYRVFREDEVLLDIFTFEILETFIESLAMA	1119
TRICHOPLAX	NAKSLKRLYSLASHPSAIKRLGALAFNNIYVVLREESTLVDTFIFEILVNYVNSLALS	1099
STONYCORAL	NIKSLKRLYSLALHPSASKRLGALAFNNIYTVFREEASLVDIFVLEILVNYLECLCLS	1130
STARFISH	NTKSLKRLYSMALHPSPFKRLGALAFNHIYTVFREEESLIDQFVCEILVTFVNSLALA	1136
LANCELET	NIKSLKRLYSLALHPNPNFRLGALGFNSIYRDFREESSQVDMFTFELLVTFVESLALA	1136
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APHANOMYCESE	GSD-----S-----ALSLHHAVDHMEKII LKSAP-TLQHENPDRMILGG-----SGC	1046
FLATWORM	DAD-----DA---SLGTVEQCNLALDHLERIMVERAA-TLKVESQGRRTPLGSKWTS---	1211
STYLONCHIA	HNS-----IEFSQEVINDNCIMMLEKVSQVQVKRIS-ILMNVPKRSIH-----	1138
TRICHINELLA	END-----DE---LYGTVDECKQA IKHIRRIILHNLD-MLQIHNQVRRTPNE---WSQ---	1144
HETEROSTELIUM	GAVADEGDDTTLEVEVGEKLQAV IDAVRVVIERRAE--LLNRTNNNRREH-----	1254
GLOMUS	DND-----QS---ATGTRQQAISAIRHLKIIIVKSN-LFLNDTPRRRKFPN---LNR---	1216
MOSS	ELD-----DE---QIGTMQMNKTVELLQRLVTRNIT-LLEKKRKRDP L-----F-----	1171
TERMITE	EET-----DS---ILGGQEVVTVAVNHIERVLKEKAS-LFNKEDNIRRKPEE--FEG---	1121
SALPINGOECA	HRD-----DP---AMGTATHTERVLTNLRRIILKKAD-KFRRTSRVRRIPP G--WET---	1156
ROTIFER	END-----DK---MFGTQEQC KGLDHVERIIFKSD-ILNQIDPKRVKPPG--WSE---	1174
SHRIMP	QVD-----DP---ALGTHEQTKSAINHIERIIRVKSD-LFQKKSQRRLP PG--FGD---	1144
SCORPION	HYD-----DK---ILGTQDKCKQALNHLERIMEVKAK-LLSKTSKRRRPLRN--IND---	1160
SPONGE	HKD-----AQ---SIGTVDQCSLSL DHMSRII KAKSSTCLSKANKNRRVPRG--LKS---	1167
HUMAN	HAD-----EK---SLGTIQCCDAIDHLCRITIEKKHV-SLNKAKK-RRLPRG--FPPSAS	1162
ESHARK	HAD-----DN---SLGTVQCCDAIDHLNRIIKQKAS-ALNKP IK-GRVPRG--FPPDQF	1166
LIMPET	HKD-----DK---SLGTQECCA AVLKHLQRIIIFHED-ILKPKSKIRQEPRE--WSN---	1148
LINGULA	HHD-----DK---SLGTQEQQVQLNHLERII VNKAA-LLCKDSKIRRKPKT--WNK---	1165
TRICHOPLAX	HTD-----EK---SLGTQEQLSKALAHIERI I KAKAS-TLNKESKNRRTP TG--FMTK-T	1147
STONYCORAL	HGD-----EE---ARGTQEQCQVVIHLERIIHSRAQ-LLVKENHRRRIPRG--FASQSS	1179
STARFISH	HHD-----DK---SLGTQLHGVEVLNHLERIIIRVKAD-MLNKESKIRRIPRE--FPAGVC	1185
LANCELET	HHD-----EK---SLGTQAQCVAVLTHLDRITTKAD-LLNKHSKVRVPRG--FDRESF	1185
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Supplementary Figure 4: CLUSTAL All phyla small

APHANOMYCESE	LNLESFTSWLFSNIANASPDFRNRCKLKFVTLT-----RMVGMTGSC----	1088
FLATWORM	ATLEAVAVRWLVGQCQGPESACRAAAMRLLVNDGSPTRDRSRVRGGLARCLLTSPEKRRQ	1271
STYLONCHIA	QSVFTFILYLFEFKVAIETVCRRESMKLFEAYIV-----RCIPPTNIE--NM	1182
TRICHINELLA	STVHCCCDWLLNMTWTSNYQFRSECFISYQELT-----DAEI-----E----	1182
HETEROSTELIUM	KDLADFVGVWFGEVGRMERRVRFTSIALFGRVV-----QLLPGQKRA----	1296
GLOMUS	SDLSSLTEWLFIEITSRKEQDYSSMCRELFGFV-----KLLPDFKFG-----	1258
MOSS	LALDDFLQWVFEQTRLLHGRSRTKCMLLFCISIC-----LSIPGCSSA----	1213
TERMITE	ILLKDAVSWLLKCGTVQVECRHKCMELVYVLA-----PLLPVCKSG----	1163
SALPINGOECA	CTLAEMTRWLSLTHACDLHAARVHQAAMAFFLHLA-----PLDTPPETG----	1198
ROTIFER	PVLEAVAVRWLMRQCGRRIETECRHKAMELHSHKLA-----PNISGVKDI----	1216
SHRIMP	GTLVDVLKWLFEQCGRPKALVRHTCMELLASLA-----PQVKGCSAV----	1186
SCORPION	SILPEVVEWILKNCGLQTECRHKCMELVFQLA-----PCLSGFNGC----	1202
SPONGE	ADLSILTAWLLAQCGSIETEARMKCRKLLVQLA-----PPSSNVVNI----	1209
HUMAN	LCLLDLVKWLLAHCGRPQTECRHKSIELFYKVV-----PLLPGNRSP----	1204
ESHARK	VSLKEVVMWLLTQCGRPQTECRHKCMVLYEYELV-----PLLPGNKTP----	1208
LIMPET	KTLDIAVWLSRQCGRPQTECRHTCMKLVYNLC-----THVQGNVYFV----	1190
LINGULA	ATLDICVWRLLRQCGRPQTECRHSSMMLVYKLA-----PCVPEFQSV----	1207
TRICHOPLAX	VTLHHVVNWLVQRQCGRPQTACRHQCMQLVYGLA-----PQLSGVSTI----	1189
STONYCORAL	ITLIHMIPWLVKQCGRPSSECRHQCMLRISKLA-----PLLPGVNSA----	1221
STARFISH	PTLSMLVIVLLRQCGRPQTECRHQCMLIYKIT-----PLLPGHNTF----	1227
LANCELET	PTLPDLVTVLLQCGRPQTECRHRCMLLVCSFL-----PLLPKPS-----	1227
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APHANOMYCESE	-----KEWLKQYQ--KSHTVGQLIDVLAPQELIS-----LYFIEGM	1122
FLATWORM	TAASPRQFFQALL--KQFKANYFYDRWERFQPHQ-----NQQQH	1308
STYLONCHIA	PDNPVKWIFSYL--QRRGEKAIKRFKAKISFIEQNYDDQNDQLNHRLRSEAVRKTMLSE	1240
TRICHINELLA	-----KLHFLRHI---GTSIFGFIDHFERSHRVSLG----SFSIC-NLQDRVIKGTSTIYA	1229
HETEROSTELIUM	-----NIWIQHQV--KQHGLAALIKMAEPPQTASA-----MPPKL----DGNNRH	1336
GLOMUS	-----FRWVKARI---DRDPKFLESLYKNSLSPSN-----VLHKGAAQQ	1296
MOSS	-----HWFRANIC--SGDQVSSTVKQFDVGM-----YPHHPSLQQ	1247
TERMITE	-----SEFVSWYA--ATHSWTSIRICEGSKE-----S--GGITVTPTLK--HLRNEVALVY	1209
SALPINGOECA	-----KPYATAHAWVAAFGAPALVALVEQGSAPQPL--LGVSVKP-----LEHSRAS	1243
ROTIFER	-----KDYFNIRL--VNESEMYFLARFEGSTLGKEILK--TSLSTYQSFLDLTGPKFQFGL	1268
SHRIMP	-----RDFIEKYV--GISKLSIIVDILEGGGEAKMG-I--SYVKNPTAS--SKHIGSSLDK	1235
SCORPION	-----KDYFSHLL--ETKGGKFFLNCFESEMSN-----TVP--SFNQDGLKP	1241
SPONGE	-----RMWIRKTI--ESEGGNYFVTRFESHGH-----SGILKAPTLA-P---APNINI	1251
HUMAN	-----NLWLKDVV--KEEGVSVFLINTFEGGGCG--Q-P--SGILAQPTLL-YLRGPFSLQA	1252
ESHARK	-----SCWLADVL--KERGVSVFLIGKFESAGSDHAK-C--SGIIYQPTLK--DLQEPFSVRA	1258
LIMPET	-----SFDLID---IVDKSTIIKKVFEGGATATHG-K--SGISACSTLL--KISDTFTLTS	1238
LINGULA	-----QGFQKFLKMESSGFPQYFMERFEAYIR--GGT-R--FTLKMCHTLG--DIGEQFTVKN	1258
TRICHOPLAX	-----QDWVKTII--GSSSVTFFITRFEGGGS-----K--YGIGRYQTAL--DISDTFNLRS	1235
STONYCORAL	-----ADWMKKT--HEDHPSSFVHRFEGGGG--GG-Q--KGIEQYPTLA--HIGGHFSLKE	1268
STARFISH	-----QTWMQNTL--KEKGPDYVSRFEGGGVKAAS-R--SGISKYPTLS--TMGQPFVSKL	1277
LANCELET	-----QAWMKERL--KEDGPDFFITRFEGGGGKGTGH-K--SGIKKPKIS--TMDSTFTVKT	1277
APHANOMYCESE	KNVWYETLAASTECCYTWACISITLGNSSLIDENVLLDPSASMKRLSTNADVQNSHRVF-V	1181
FLATWORM	PLGPLRALLACLECHLWLSLGGGLDPPQL-----LGCGG-----GSRIC-Q	1348
STYLONCHIA	KQKTIEMTLAQIECFNFLSRKIASFSDI-----KSKL-----VDINVWMG	1281
TRICHINELLA	LVLWLETYEAMIDGYVVALNTNRISMEAW-----NDYLL-----NEDPRVKSLLF-P	1275
HETEROSTELIUM	VEFWMRRQLASLAVYIWFYFEGFDPVAI-----SKDG-----SSRIIS-N	1376
GLOMUS	TKDWCSRFLSVLANYKWLKEKFPVPLDL-----ITSS-----GIMFR-K	1335
MOSS	EQLWLTKFVRSIHWFWEALKENIISIKEL-----LDFE-----RDCVIHIA-S	1289
TERMITE	VVRWLRMVLTSFDCYVVLFEELVKPSVL-----WGTEG-----LDNTSETRIF-E	1254
SALPINGOECA	IHEWLERLQATLEAYQLVLSHRLTTPRAL-----LVDC-----EMLLW-G	1282
ROTIFER	LVTWLKLLNAPLDCYTWIFGQRLNPKSL-----FSTK-----KSCIW-S	1307
SHRIMP	INIFLEALSASLDGYCWLIGQGIVPAAKL-----LNHS-----ELQLF-S	1274
SCORPION	IINWLEGLHTMLDCYVWVFGQSVLKLSDI-----FNDA-----SNRESKFF-P	1283
SPONGE	AINWLQSLQAQAVDNYRWLLKEQYVSPREI-----FSST-----SSSNLF-K	1291
HUMAN	TLCLWDLLLAALDCYNTFVRLAMVKPSEL-----LGTS-----QETGFM-K	1292
ESHARK	ALQWMDMLAALDCYNTFVRLAMVKPSEL-----LGTS-----QETGFM-K	1298
LIMPET	TMNWFDMLLAGLDCYTWVFGDLTPINI-----FSGT-----GSNTSKLF-E	1280
LINGULA	AVLWYDMVLAALDCYKWTFTDNLRLPEDV-----FTGG-----HSSCIY-L	1298
TRICHOPLAX	MKNWYDYFLAALDCYSWVFEKMSPEQI-----IGDK-----AQLGSKIF-G	1278
STONYCORAL	TILWFVFLAALDCYTWVFEKMSPEQI-----FTSSE-----DNEMPSVLL-V	1312
STARFISH	ACSWFDHLLAALDCYTWVFEKMSPEQI-----YTAT-----ARRPSVLF-Q	1319
LANCELET	AVSWFDLLAALDSYCWVFGQRFVSPSDV-----LSGS-----GKKPSQLF-T	1319

Supplementary Figure 4: CLUSTAL All phyla small

APHANOMYCESE	AAKHFFA-----N-----VDEPTQARNRAFEGVCKLV--	1208
FLATWORM	RLSDFFNETDPSLDPGRLLALSASVS-ASS-----AYSNSISEIRASAVTIRCQLIVR	1399
STYLONCHIA	NLYSFLADHIVIKFVKNERKSL-----DKLLICKEDKEILTKSRMVLITQ	1326
TRICHINELLA	CSLDLVN-SIVI-----G-----RHFPNLSKAQRNRLNKRCKSFVA	1311
HETEROSTELIUM	AFYVFLS-EYALVDQSH-----P-----AMASLTPREIDQFMTLKCQTLHEH	1416
GLOMUS	AINYFLE-NLVQNDIEYLTPDAMEIDDGEYFIKKNVGSSENLTPAQKQLWLTRKIQIIEH	1394
MOSS	SISAFLO-SLLKSQD-----S-----IHQFLDLTPGEQDELQKLYEATTH	1329
TERMITE	AAVYFIQ-HVCHRDAASVTCLLSTD-----TK---DVLEITPWEAESFDRTKCFVTIR	1303
SALPINGOECA	ALAHFLS-TFPRRSE-----LKRHDTPAEAAAARYLKCTVMVR	1319
ROTIFER	SVEIFLD-KVASFSLQNFSLSHNYTE-----A-----HILFSPNEIDEYNGLKCTVMIR	1354
SHRIMP	ATTYFIN-EMALLTVSEYMKNHDAF-----QNAVATPYETEATAKLKCTVIVR	1321
SCORPION	SIEFFLK-TLCIDFDQRVQAFFTHE-----SV---KKQIFSPKKEDEYLRNLNCFIIVR	1332
SPONGE	SIDHFLK-CIALVGIEGVNSPEVA-----M-----ATS IHERGEYQRNKWCTIEL	1336
HUMAN	AVAFLE-SIAMHDIAAEKCFGTG-----AA-----GNRTSPOGGERYNYSKCTVVVR	1340
ESHARK	AMNFFLK-TLARHDITAAEECFTLG-----VK-----GVLFSRPREREYNYCKCTIIVR	1346
LIMPET	SLEYFLS-NISLRSIDEVSKLFKES-----S-----VEYFTPREDFNRNKCTVIVR	1327
LINGULA	VLSHFLS-SIALKDIEAAADLFTRG-----LD-----RKIFTPWEVEEYNRKCTVIVH	1346
TRICHOPLAX	SIEFFLS-KLCLHSLDETVKLLYSK-----ST---LQLFTPREIEEYNMCKCTTIVR	1326
STONYCORAL	SLKFFLS-HLAMFGITEATSCFTSG-----PSR--GMGDIFTPKEIDDYFRAKCTVIVR	1363
STARFISH	SLQVFLS-SLSLLDITGAARGIEYG-----GSKTSAFHQVFTPRESEYNYQEKCTVIVR	1372
LANCELET	ALEFFLT-KLALSIDIDAAARCFESH-----GA-----ATLFTPRETEDYNYGKCTVIVR	1367
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APHANOMYCESE	-----TLAINSETS--LPLLSKQVDQSLVDNKFLEFVVQARIEPGRV--GLKEFSDTQ	1258
FLATWORM	TAALLQLLAGKQPD-----LKDLLQKENSNGLWLTALARATLRPQLL--GFDAQD-PS	1450
STYLONCHIA	FLRYLDQDLDEESLLA-----HADLFQKNCNFNIHFCVQIMVIPLIHQLQVLVED-QE	1378
TRICHINELLA	LCKLIAALISCQNLN-----NYQGFLKLLLYPNTWNAFLKVACDPKSL--GFRLYS-KQ	1362
HETEROSTELIUM	VYALFSMLLEKYNYSQ-----VMTGGLQLLRVVGVSLLTPAVV--GYRTID-NN	1463
GLOMUS	LIGNIVLFKETDPNN-----VESLWNSNINGQFYKLLGNCLLRPNI I--GLDQLP-DN	1446
MOSS	LMKFCSQVLNAQSGYAEIEDLALRTIFMPDQSRVYFQQLLCLVLLKPRQL--GLVISE-LQ	1386
TERMITE	LLDMISTVLKSGEA-----GCLPHSLLNLQWQLIVACVLHPGSL--GFDLYN-TE	1351
SALPINGOECA	VLDVVRTVLRVDA-----SALPTKLWSGECLEDFICKAVLMPIML--DFDPSD-PE	1366
ROTIFER	LMDFLETFIFANYSKE-----SLDVI PMSLWNSNFFGLVINMMLNPTS L--GFSLKN-LE	1405
SHRIMP	LLDFVSVVLQEGPKV-----ASLLSQHSVWSATMFSLLTCCCTLDPASV--GFDIKD-TY	1372
SCORPION	LINFVTTIVENYHLQ-----LNTIPSTFWNSINFWNCIYSSVNLNPKFL--GFDMTD-TY	1382
SPONGE	LLTFIELLLTKHTSET-----VSFEYVVDLSWSQELYTI VMDSL FYSSLV--NTAPDD-PS	1389
HUMAN	IMEFTTTLLN-TSPE-----GWKLLKKDLNTHLMRVLVQTLCEPAS I--GFNIGD-VQ	1390
ESHARK	IMEFACILILEGLQD-----CWKVKLEKDLLNSDLFELIAMVVIDPTS I--GFNMAD-VQ	1397
LIMPET	ITNFLSVLIGKYPKD-----AIKVIPTVWSDTLWELLIKCVVQPSV--GFNMGD-VE	1378
LINGULA	LLDFLCSTISKSGSH-----LEQVVPNSNIWCPDLWILICDCVNLNPSAL--GFNMGD-VE	1397
TRICHOPLAX	LINFLAVLLQMSPTS-----IIEGIPRQIWSQNLFEMIFLCILTPHQ L--GFNVGD-IE	1377
STONYCORAL	VLNFLTILLQDFPQE-----TLKTLPPFFWSEDLFEVVLSCVLEPGVV--GFHMGD-VE	1414
STARFISH	LWDFLTVLLENYASD-----AVKVIKSIWQDSLFDLVVTCILQPTVV--GFNMAD-VE	1423
LANCELET	IMDFFTVLGAFPQD-----AYKVVPAVWKSPLYDMVVTAALPTAL--GFNMGD-VE	1418
APHANOMYCESe	V-----WMNLCQS---LLRRQNLLFRNVLLQVLSN--SPY--	1288
FLATWORM	L-----MAKLLDC--LSTAWHAVARNLAPVGSSYRSSIVSAIAAELELAGQSVTV	1498
STYLONCHIA	L-----ERQLRNQ--SELLRKLVAI-----KNL-DLAKI IKKD IVP--SMRCIN	1418
TRICHINELLA	F-----FECISQD--VRLFLALKNN-TFLVQQVSTSMKEYLTQFYYPW-P-----	1403
HETEROSTELIUM	NNASNSGNKQVNELPLNLIVDRVCQLIVN----QGDKYRDTLIGYLGEMISS-S-SCNL	1517
GLOMUS	IV-----KQKLI IQ--VETLLKLFKK---LSINNVTQLAQDLAET A-----FSD E	1486
MOSS	R-----AQDLAKL--ASKVLTRFTQ---LSSNLKSEMVELLRVIEG--DDPAYD	1429
TERMITE	V-----TDGLPKN--LIQLLGVLET--LPSSQLEELNSELGKAVSS-M-QTEV	1394
SALPINGOECA	I-----EEKLPK--TGVVLASLCLS---G--EPRTNLVAAMRTLAS--DECDL	1407
ROTIFER	I-----FSNLSPK--IRQFYKLVIQN---LPTDKQNKFRQCCQIILD-SRELNL	1449
SHRIMP	V-----SKHLP SR--LEEILGILARR---GPSEVIGEYSDYLEKQLQK-P-ENDI	1415
SCORPION	I-----FNQFPKE--TRTLKVFY EY--MPKPLYNNFNEHLYEYLE--SKCNI	1424
SPONGE	T-----AKRISEA--AVSCLTAMCTS---LPIDVKQNL IAYIASNINT-GQTNV	1433
HUMAN	V-----MAHLPDV--CVNLMKAKMS-----PYKDILETHLREKITA-QSIE--	1429
ESHARK	V-----MKNLPNV--CVKLLNAVMS-----PFKETLVDSVRKRITA-QSIE--	1436
LIMPET	V-----MNNLPSE--VPTKLMFVGIT-----NFSDL	1402
LINGULA	V-----MMKLPEQ--MEQVLRIFSR Y--LPPKALDMFRRTLKSKLDS-G-SYNL	1440
TRICHOPLAX	V-----LEKLPQ--MKDVCGLFQMK---LPKDKRELMITLKEKLSR-NRSYNL	1421
STONYCORAL	V-----VEKLP EQ--TGVLCCKLVQR---LSGECLERLKGTLEKKIAL-GSHCNL	1458
STARFISH	I-----MNNLPKT--TRKLLRLMSTH---LPANLRNNLSKAVTRS VTK--SSHDL	1467
LANCELET	I-----MEKLPQE--TKQLLLMCRS---LPSQQGALLKSQVAAKLSR-RSSHDL	1462

Supplementary Figure 4: CLUSTAL All phyla small

APHANOMYCESE	-----RRENLFDMDSNLVQWICATYSELHKINFWSHDQOE-----D	1324
FLATWORM	QRLLPQSGLAS---DPPSVAGAVRLARGVRLRDCGL-LADSTA-----DEKRQILD	1546
STYLONCHIA	LNHMFTVDN-----VQNYHPKMLMSMCLGYLKLASIDPNIKEYLI-----SFRSLPT	1464
TRICHINELLA	-----DVE-SVVTCDSHLAIEQQQLLNQVYGMVVEVGL-QSVVEL-----PRAEFLWT	1448
HETEROSTELIUM	GEIGVLI-----TTEGTDRLVSLINGYNIHQKQSI-LDVTLK-----FAKLSLPA	1561
GLOMUS	VDLLNIEL-----DKSDPTYDQITHGYLVLSSSGL-FPDLLHEHMTSYMNTSSKL-YD	1538
MOSS	LNLSFSSKISGPKALSLEDALSLVKGYQLLSQVKI-LPLVLN-----KVRAGKLGFR	1482
TERMITE	LSNLQDSL-RN---DKVTLEQRQLLKGLEI LHKCGM-LSHIVKELPNQYGLDGNQIVKH	1448
SALPINGOECA	LRMVRDVL---PGRDIPAPLIKNNVSVGQQLAADL-LDECF--T---DRDAFGRE	1455
ROTIFER	-----DFVLVKDIDWINLSQTIAGYEILSDFKIFKITT-----D	1483
SHRIMP	IKMLPLSL-SETA---HINLRSRHVIEGIGILEKSGW-LAKCNV---V-SYSVAKELVDW	1466
SCORPION	YNLFPLNL-ND---KDLKILEIQEMLLGYEQLIENKLW-----P---KQNCNKSKKLCD	1472
SPONGE	INRLPVSY-NEST-TSSGILLFNRLVQGHYI LAESNKCLSDVLR---SMGISEEESLMR	1488
HUMAN	--ELCAVN-LYGPDAQVDRSRLAAVVSACKQLHHRAGL-LHNILP---SQSTDHLHSSVGT	1482
ESHARK	--ALCNVD-LYSPGARTDHAGRLSILSACQQLHKADL-LNSAID---CEAGLSLSSLSLK	1489
LIMPET	FSLLTNLS-LN---NPVVGHTVQLHLVSGYILNKTGL-LVNTNV---QQLVF-DTVYKVC	1454
LINGULA	LKKLPHIL-SGPSE---DHMTDSHLVAGYQLLHKTFD-LLPALK---DGHS-AENVSNN	1491
TRICHOPLAX	PDLLPIRF-DRDNELNIDFERLTFLIKGYQLLTMGI-LKTPA---D---HKDLIEK	1471
STONYCORAL	FDQLPFPL-SNPQEHQVDCRLRAYLVQGYQLLHCAGL-LLPALK---AQARNASEEYAVK	1513
STARFISH	TKLLQSMF-GRDEGLTTHGKLIHLVKGYQLHQANL-LSAAT---G---HSGSSFAVK	1520
LANCELET	FSHLPEVS-AG--VAELDHVRLTLMVSGYQLLHNAGL-LLPA-L---G---TNSGKSLASE	1512
	*	
APHANOMYCESE	IANDFAN-----MAIAE-----RKNNTSRPIRDQIARTAMQTAIEMGWLASFI	1368
FLATWORM	RCCQLAE-----S---AQTTQHPVLPQ---LIDAALTYAL-NDSAL	1581
STYLONCHIA	IVEAWF-----DIDTPISNESARVLVKFLSKLEI-PNETL	1498
TRICHINELLA	TVADVY-----FSKRIGLPPSKLGMVKQIFRVAALTS-AVDVL	1486
HETEROSTELIUM	MTSTLFDYLN-----EHVDNITPAHLIVYKEILVFILSTGHIQPSK	1603
GLOMUS	YILAIWKKFN-----NLRDVSDDLWVELIRKLLSFALSLSK-YNGAI	1579
MOSS	LILTVFG-----I---EQCPPSLQPIAEMVNLAMSLGV-NATFL	1519
TERMITE	LFSALVE-----GQ-GDMKRTVVLQPAAFSYAESLLKFAFLNKN-EVTV	1491
SALPINGOECA	LFAALFEY-----SHTSTPEPTNLAMAGLLADLALSLSV-PKSQ	1494
ROTIFER	MSKLVF-----DLSQEETESQ-----TTEAKRKLFSCLCSINR-N---F	1519
SHRIMP	LCGSIFKEQN---LSVS-----GISPHPSLKLFLYTVMQLAITLDP-KVKHH	1509
SCORPION	MLSSVWE-----SCILE-TEIGCC-IPILNPSVLNFGKMLTVALKLDI-SSEDL	1519
SPONGE	LYTNALT-----IIRGISSSPGDGP-GYMPPLHKLGTGELLKLGLELSD-SVEPF	1538
HUMAN	LLSLVY-----KGIAPGDERQC--LPSLDLSCQLASGLLELAFAGG-LCERL	1528
ESHARK	LLSVVY-----KGIAPGDERKS--LPSIDVSSKQLADGLLQLSFSLGG-QCEE	1535
LIMPET	IYPQFFLGMNIPVSPFSGIYE-EKGKLLKIITLTPAASILGKSLDLDFKGL-KDNVL	1512
LINGULA	LLQTLF-----QAVSEEDQ---FRLECSPTLELSRKLLELACSMTD-KPAQI	1536
TRICHOPLAX	IMKSVV-----DCFRGEMNGD--RTALSPAQQKVAEELDLAFELNE-TIDIF	1517
STONYCORAL	LFTAVY-----DGVKPSLNVGLQ-TVILDPASQHLASKLLDLAYDLGL-QFNYL	1560
STARFISH	LFITVF-----DSLTTSDAEGKLLQANLTPLSVELAESLDDLAFLLGI-EAKML	1568
LANCELET	LVS AVF-----KSMVTRKD-GHPTAASLPPSFHQLTGGLLQLACQLHP-QGHDL	1559
APHANOMYCESE	LKSTDENYDLFAS-----TF-----DSSLHKSSIWLNVAVGFMSNIENYES	1409
FLATWORM	LQPLVT-----LLTEHSAGLDLLNSYKPCLTAYFS	1611
STYLONCHIA	CEWLTKKHL-----LYQKSSDLLLSYIA	1521
TRICHINELLA	IKLLMNTESVRLA-----ECTSLCSTKGELLIANFSDEIALIIC	1525
HETEROSTELIUM	LEYLLPPIKVLTKSTTTTTTSSITDKQLEEEKRRQKQIEHQSNFYKTYHSELIEYIS	1663
GLOMUS	NQWLLSDIIGFPS-----DNSTFYQNGTIYQKQFSSVINEHMS	1618
MOSS	VNLIMDEKSVGIS-----TNRKLTSGEVFYMFRDTIVHVQK	1556
TERMITE	ICCKEQASIQNP-----ATHSSVLHGDYFFVTFRSAILEHML	1529
SALPINGOECA	LAMLRDDTPTPQAGHSLSTML-----ASASKSATQTTTRGALFYDTRTVLAPYIA	1544
ROTIFER	LTKILQNYL-----EEQSANVTLSYFRAEIFTQCL	1549
SHRIMP	LLSWATNSDTSVSG-----TS-----GQEVKESHVLSILGPKLIPQFL	1547
SCORPION	LKKLLDEQQLYVS-----NLKTKTRRGLIMFSTYQQELSLFAG	1557
SPONGE	LLLVLSPAQSG-----AGASFAAQDGLLLYITYSGLINNKLL	1575
HUMAN	VSLLNPAVLSTA-----SL-----GSSQGSVIFSHGEYFYSLFSETINTELL	1572
ESHARK	VSLLNNTMELSV-----LS-----GATQKNFITFSHGEYFYSLFSETINAELL	1579
LIMPET	ITALLNDMIQVK-----TPSVNLQHGAEFFLMFKSVICQYIA	1550
LINGULA	LGAILSKTKTK-----NQNSSQNFYAMFQSTINLYLM	1568
TRICHOPLAX	FRYLLDETPLYGD-----S-NSATATLGMTLYTFNSNINAFIA	1555
STONYCORAL	MESIMEDSN-----DNPSSCGCTFYRIFQTSINGFFI	1593
STARFISH	VSCLLDKTALFSG-----R---SSTSKGAVFYTFKTKLNGEMA	1604
LANCELET	LDCVMNKTPLMTG-----GGKKSSTFQGMVFFSTFKSICQQLI	1598

Supplementary Figure 4: CLUSTAL All phyla small

APHANOMYCESE	CALNTFQRVLEANPKSSD-----GLAPYVNDFAKYALS-----	1442
FLATWORM	ANCQSLLTILAASPLLKAATAPATAAAATLARLPALAAI LESLAAS----VKRTALSQKGC	1667
STYLONCHIA	ENWNHFKLNVGEYLI I KAKDEP-----SLYAVFIPILEKLSQ-----KTPN--	1562
TRICHINELLA	TNAELFLKHL----KEASRCQP-----DVVGRALFHTVSVVVH-----SSDLRKK--	1566
HETEROSTELIUM	KNFESFSPLF----IDRIVQTN-----HIDTILNDICIYKQTIQFNNTTDKQSKKN--	1710
GLOMUS	RNFREFAKIF----FDNINDFTRDQMNIDI I KDILNLIDY LIS-----KKDTQQS--	1665
MOSS	FFYKDCRLI----LEAAAEKQ-----AARMLLIALLDSYLK-----PSEMGAS--	1596
TERMITE	ACFEHSVSCL----IKDISANN----VQWVISTVTEILQYYAK-----IRKSKHQ--	1571
SALPINGOECA	RHFVFAEQL----LPHVGDGR----VYRLV--HDAARALVTG-----DTEMRR--	1583
ROTIFER	NFYSDILDFL----FSKL--SSK-----FSKILQFLINFEVIAM-----DKHLRKT--	1590
SHRIMP	ESPDALSRC----VEMIREGR----FLPAMGFASALLTCLIR-----NADIRKK--	1589
SCORPION	INSKHFISL----MNNINKSK-----TTVLKILVGLD SIGK-----VKEFRYR--	1598
SPONGE	LHIKMAIDVL----LKNAKTHP-----QQVSVILNLLLEYVQK-----DFKINNNNN	1618
HUMAN	KNLDLAVLEL----MQSSVDNT-----KMSAVLNGMLDQSF-----ERANQKH--	1613
ESHARK	KSLKSAVTQL----MRSASENP-----KMVSTVLNGMLDQSF-----DHTVRKT--	1620
LIMPET	ENGRTIIPIL----TNQAKTHG-----RKVNSILGATVDYIAR-----DRTL RKK--	1591
LINGULA	KEAKYPIPEL----VNYASKES-----SVVSVLSLLEQISR-----DRQLRGG--	1609
TRICHOPLAX	KVSNRCLPMI----LDLAASKS-----FMISGILSGLDFILR-----DRGLRQS--	1596
STONYCORAL	ERANIHMANI----LMKAASSP-----FLVLSLLNGILDQVIR-----DKILRTR--	1634
STARFISH	VQAQKVIPLL----VREGKDV-----TVVSSVLNGLLDY LTS-----SREVRRT--	1645
LANCELET	KTCAESLPVL----LQQLTAE-----VWVGSILHGLLDHLAK-----DKTLRKK--	1639
APHANOMYCESE	-----TAAKQSSLLKILDQVFNNFQDV-K----S	1467
FLATWORM	ADDPKQLASQILAKWTLV--QQLWDYG--NDDCRFSVLGITNLLAVDAELVKS N--	1719
STYLONCHIA	---YKILLRSVPENWNEQERTDFTEFE---VATSKVKIYTFIANACQVQLR--DRS--N	1612
TRICHINELLA	---YGRELALQILQIFGQE--LLYWADVVSNETLKMWLKMLMKLILIDSKIT-----E	1616
HETEROSTELIUM	---DMKSIMIPFLIKISS---HLLKDV--GKTDDKENIIEFTKNLINIDTPTFFET---	1758
GLOMUS	---VEFLIHLNSEFYFL--KSFVKI---CT--YDRHYLLKLVNGLFMLEPNLRRF--S	1712
MOSS	--ITKSSFMQEFLOHIEVL--APLCRAG--SSLTRLRFLDILHKLMLDGTGKDVV LNIK	1650
TERMITE	DSTTLCAFERSIVNHNWKL--SSFVEGN--SEQVYQ--LLGLVNLARIMPQDRGL---	1622
SALPINGOECA	---YADEFFTAFLDGF LHV--RTWINSAGAGSETHVQGMRLVSAVVRGVRPETAQ--R	1635
ROTIFER	---NGQKILKVFESWPKF--EPYWSFE--SQ--FKILMISLLTKCLMIESPQ-----S	1634
SHRIMP	---YSVKVQSFLKHWP T LAAQ---AG--KTSLHQDVSLSLSSLFLIDREGT IKSH-C	1639
SCORPION	---YGKDIINSIMCQWSRL--QQCLEES--CDIDLQNDIITLITKMF LIDSSFIKGN--V	1649
SPONGE	NKETVETLCTELISHWQDL--SLWVEDG--SKDLKSAAVTLLQKIIALKPKLLKS--A	1671
HUMAN	---QGLKLATTILQHKKC--DSWWAKD--SPLETKMAVLALLAKILQIDSSVSFNT--S	1664
ESHARK	---QGVLLVSAVL TNWTRL--ESWWSEN--SSAESKMAVLTLLSKVLQIDSSVSFSS--N	1671
LIMPET	---EGPNVASTILSEWKKF--STWWTNN--APPELQNLAISSLTKVLLIDSRVTSHT--S	1642
LINGULA	---EGKTVVDVVLSCWSQLQQLQW WAPD--SPQEVKMSALNLLRKMLLNGKVVSDP--T	1662
TRICHOPLAX	---KGIHISKILSSWNSL--KCWWLTP--DAQDLLQISVNLNKCLTLDPPQFATQS--N	1647
STONYCORAL	---NGSSFVAVLLNNWTSF--EIFWRTH--SAMD LRHSILMLKMKLIDPAKVTD C--N	1685
STARFISH	---HGMSVHSAILTQWDIL--MGGLKKG--CSTDLQSFALLMLRKL LQIDAKFVSDT--T	1696
LANCELET	---EGAALCDSLLQSWPKL--APWWEEG--ALQDSKSTALTLLRKILIDSQVSRDP--A	1690
APHANOMYCESE	LALF--DCAL-GIKQVLC DK-----SKAASLKVDAMHIIPHMLKFS-----	1505
FLATWORM	-----DQVFVLFVGV LNS-----RVNFDLIVNGLALLGYMCRNPS-----	1754
STYLONCHIA	HYAIFIDHLCCEKVS KYLKE-----RYPVHIKREVLNLVGM IYNLETQRENEF	1660
TRICHINELLA	WPEF--APMASAYFMLNDQ-----SLTLD FKNRMLSLLAGFCTFD-----	1655
HETEROSTELIUM	KEGY--DFVYQLL INYLNR-----SNSLAFKNKALVLLPDLLLFPK-----	1797
GLOMUS	LEEF--QNLFRENYEAFLDK-----QIDLEFKNEALDLLPFYFKSDL-----	1752
MOSS	YSSF--DFITETFLSFLSCSSE DATNSRLGSSAAFTLR TSMRLLPFFFSANVD-----	1702
TERMITE	-ARC--EALQKWVITQLTSR-----DLQLHYKSRALDLLVCLAGPQ-----	1660
SALPINGOECA	HANF--EQVLEVYKRFL EDR-----AVDMTSKRVALQLLGPLCKGT-----	1674
ROTIFER	-PKN--EKVFQMYFEFLTDE-----KSM LNFKAKVLDLLHFFFTNSP-----	1672
SHRIMP	TSSR--SDMVVFYNGLLADA-----KVELQAKIKVLLKLPFFFTMG-----	1678
SCORPION	NYDS--NSIFFSFITLQKS-----EMSLEFKICVLDLLPFFLC-----	1686
SPONGE	DVS--KPLVDMYTAMIGDE-----KLELNFKAVMIDLLPSFLLLS-----	1710
HUMAN	HGSF--PEVFTTYISLLADT-----KLDLHLKQAVTLLPFFTSLT-----	1703
ESHARK	HEAF--AMVFHTYTTILTDS-----TLALNLSQAM ILLPFFAHL P-----	1710
LIMPET	HPSF--STIFEMYQTM LVDN-----KTNLAFKNKVL DLLPFFAMAQ-----	1681
LINGULA	HPSF--SCVFSMYQSM L TDT-----KSSLLFKCKVLDLLVFFAKLP-----	1701
TRICHOPLAX	DSSF--ETVFNFFLSL SGT-----STSLAFKKYVLDLLHFFLVSS-----	1686
STONYCORAL	RLTF--PSLFEMYL LYLKDK-----STTLAFKQVLELLPYFTKST-----	1724
STARFISH	HPVF--SSVLEAYSFMLTDA-----STSLTFKAQVMDV LFFFTSLP-----	1735
LANCELET	HPAF--QPVFTMYLDM L TDS-----RSTLPFKSQVLDLLPFFTVLP-----	1729
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Supplementary Figure 4: CLUSTAL All phyla small

APHANOMYCESE	PDCTEIMTEGIAHLVVHDFPVNSNDITK-GTVAFDAFEMLFQSYLFLVVKSSQIVLLKTL	1564
FLATWORM	TERAERLSSQLKLLCSETVLMRCSNQLGINSHAYCQYVRAFRGLLLAQETSEHPLLEIL	1814
STYLONCHIA	VHDKNINFSLRTLQSQFFPIKTRRELVR-NSNVYNNFHIIVEGFLSLLILSKNLKVLRLMI	1719
TRICHINELLA	-RHACELGRSLKLFMVNNFPLKSDFAK-GTAKYDQHVAAACQKILFAFGCTGSPILLELL	1713
HETEROSTELIUM	HHNYNLIQEKLINELVVYDFPLSSKDLTK-GSPIYNEYITTIERFLNTLEITCNPMIIDTL	1856
GLOMUS	--PKEKIESCIEFILYQQLPTDSKDYSKFGTKKLNLYSLVDKMFKAMVRSRVSFLFKIL	1810
MOSS	SGVHSKLIRILSGIVTDYLLVREADIPIQ-GSIQRSNYTQLLNQLLAAVSVSHSLELLEVI	1761
TERMITE	EDTNQELRSALQTLREQHFPQLSTELHS-GSVGYSGFVNAFRKILRGLLESGSCVILLSV	1719
SALPINGOECA	QHVRTCAASLNAFQCAFPPLRSREYAV-DSTQHREYIAALDDILDALVLSGSLELLEVV	1733
ROTIFER	----KFKVLSQF-MSQLPLRSQDLAK-SDDIYKDYLVNVVHKLVLVCLLESQNLDMLSLL	1725
SHRIMP	EDIAKSVSEALEMLSLNHFPLHSTEFSE-GGARDREYHQAIICEILTALELSLSPILLQFV	1737
SCORPION	DAFLCKVQAALNDLFTNHFPYLSSELKP-GSSQYNDYHLAFTKLLIALELTGNEMLLKFV	1745
SPONGE	PHQSQKLGSLNRLVSLQFPLTSSSELPA-GGPLLNEYTNIIEKLCNSLVASGSVLVLELI	1769
HUMAN	GGSEELRRVLEQLIVAHFPMQSRFPP-GTPRFNNYVDCMKKFLDALELSQSPMLLELM	1762
ESHARK	EENLAVLRHALDQFVAAHFPMKSDDFPK-GTLKYNVYVDAIKLLDALELSQSPMLKLM	1769
LIMPET	ETYITKLLKSSLDRFVADNFPKSNFETK-GSPRYQDYISAINKILLALELSGCSMLLELL	1740
LINGULA	EKETQQLKACLDRIVADHFPLRSSYAV-GSPKYQEYIMALSKILSALELSGSLMLLELL	1760
TRICHOPLAX	DKRIRRELREHLDRMIVDKFPLKSAEFVV-GSPDYNDYVACIDKLLANLIKSGNMLLEVL	1745
STONYCORAL	EEYLRLRKEGLNAFVTNNIPLKSTEFVVT-GGPQYNDYVQITDKLLAAFVNSRSLILLEVL	1783
STARFISH	DGEQTKLRALSADRLVADNFPNLSSEFRV-GSPKYIDYAGALNKILTAMVLSGNMLLEIV	1794
LANCELET	QTQLAELKARLDRMVADNFPPLKSAEFPA-GSSKYNDYVGVAVTKLLSALELSLMLLELL	1788
	: : . : . . : : :	
APHANOMYCESE	FQSLKEKK-SHAFYSAIQDALESFALEVPMCRIYPICVELLQLLDFDG-----	1611
FLATWORM	SILVCKER-QHALEAEFQQCLNRLLLRIPIQ----RCRDFVTWPWRLFRGDS---GGGG	1865
STYLONCHIA	YNSMREWK--TTYEPSLKRTLKIIIEQSINK---MPLHQFKQTFSQMFDEFMNRQIDLS	1773
TRICHINELLA	LSMVCREQ-SHPIASDLKHQLQKFSRRANSA----VLENILELDDKMFN---P--SC	1762
HETEROSTELIUM	LQVLKEQD--HSHITHINQSIERFIVRTNDS---QAKEVFSHCFAMFMS-----ND-	1902
GLOMUS	IPFPCRES--DHMYGEEFQRQVSEFLSKLSRS----KYVDTMDIAYGYFTN-----ST-	1857
MOSS	FPLVQTPN--KISSRAVSEAVEVFAESLEDN----REAFNLCCTMIMD-----RG-	1806
TERMITE	VAMAASES-QHVLEDQIQKSLQIFIKRLEDK----QQVKAIEAVFKVFD-----DQ-	1766
SALPINGOECA	VTVHQREDRTHVHEDHIIQRKLRDFIVQEHTD----APQAIELMFQIYLA-----ET-	1780
ROTIFER	IGVYCREK-EHLCENQFRESLERFIKRLSSE----KQMEIVKQNSWNSFQS-----SDD	1773
SHRIMP	VNLFPCRED-KHRYEEVMHESLEKFMKKLPLL----KQQETLKHIDYMYND-----PTC	1785
SCORPION	IQIMCRES--THLLEENIQKCLKKLCRTPSDN----KERLIAEVPLKMPLE-----DEL	1793
SPONGE	INIMCREV-RHVCEEKIQTSLHQFISKLESD----GVDALKFVYEMFKN-----DKD	1816
HUMAN	TEVLCREQ-QHVMEELFQSSFRRIARRGSCV----TQVGLLESVYEMFRK-----DDP	1810
ESHARK	IAILCRDS-RHVMEEGFQVCFQRLAKTGSCD----KQVALLEAVYGMFEN-----EGG	1817
LIMPET	ISIFCRES-KHVEEDEIQDVIARYTKRLVIY----KQKLALDIPYKIFTS-----SGS	1788
LINGULA	ISIMCREK-NHVEEDRMQESLVTFIRRLPTG----HQAALDVPFNIFTK-----EGL	1808
TRICHOPLAX	ISVMCREK-KHAYEEQIQKSLLLFISLIPK----DALGALDVPFKMFVD-----DKS	1793
STONYCORAL	IAIFCRER-QHVHEDQIQQSFIAFIQRLHPEP--DQAKAAMDVCLSIFFN-----ERD	1833
STARFISH	ISIMCRDE-KHAYEDEIQESLAAFIKRLEPEE----KQTAAFGVAYQIFCQ-----ENS	1842
LANCELET	ISVMCREA-KHVMEDDIQTSLSRFIKMGAD----RQKPALDIPYGIFFR-----EGS	1836
	. .	
APHANOMYCESE	LDDYIRTVLHRQVFSRLVHQLEEAIIKLFMTMTSFGVPFVKY---LMNIVL-----	1659
FLATWORM	FTGFHREQLVSRVLAPLLTQCHGSVLLDFVAT-----DDCLEYCLTCLLNAQQSLAGFN	1919
STYLONCHIA	VDDNLRWAIMKIIILKILESCSQEFLADIMIE-----FTPQ---LEIVLKEIFL--QK	1822
TRICHINELLA	VCASLRLLALLNEFFIPFLHSLKNDLLLTWTCR-----KIQT--LVSCLETSLTL--EI	1811
HETEROSTELIUM	YQDELKITLIDKFCVPLIGHMKQQVLIQLFAQ-----HLSS---LMSIIQPLAPKYLAT	1953
GLOMUS	YVS-FQRIIIEMILSPPLLQGPKIFVMDFFKK-----HINE---IIDLLERDKYT--RN	1905
MOSS	KSYELRRRAVVEVIFEAFVNSSSMFVTVWYSQ-----HISD---LFYVLKQSSSM--LS	1855
TERMITE	YDPSVRLGCAQRVFRPPLLQGCRRSAAREFYRH-----CIQD---LQGMNLVTLDC--RG	1815
SALPINGOECA	NPLFVRRGVAQRVLATFLQACKLSMCSAFYIK-----RLPA---IMSLMSQDTPL--TS	1829
ROTIFER	---ERKFLLFKVFIFIFLKNCDKPVFIDFMSA-----NIVS---LIEVLN---WN--LN	1816
SHRIMP	IKQNLRYNIMDLVLTPLLQQAQAVPTQNFLLT-----VISA---VMAGMSAPVHG--RS	1834
SCORPION	YPSDMRIHIIIEKVFRVILGMISKITLKYFFID-----HIKE---IMQIVKSKRKS---	1840
SPONGE	FPVAAVKIGERLCVPLFTECSSAVLLEFFVL-----KISD---VMCIMEAKLAR--VT	1865
HUMAN	RLSFTRQSFVDRSLLTLWHCSLDALREFFST-----IVVD---AIDVLKSRFTK--LN	1859
ESHARK	LSNIARQSVMDRSLTLTHCSLDALKEFISK-----IKD---AMGILQSRFTK--TS	1866
LIMPET	YPSAIRIAALSrvclpmlrlvkhksaviefflt-----HISF---IMSEIEAKLVK--GS	1837
LINGULA	FPNEIRRSVTLRVCVPLRLCHQSSLSEFYVD-----HIKF---ITDTLSAKLSK--SS	1857
TRICHOPLAX	YRPDIRRAAIERVCLPMLQKASLKITKDFYVS-----HIKE---IMDIETKLVK--TA	1842
STONYCORAL	YQTHSRRAVIERICITFLKLTSTTARRAFYQD-----QIQK---LMSVLEAKELK--PT	1882
STARFISH	FSKELIRRAAIERVICPLMRLAGVKALSSFFKE-----CIKN---IGGIIDAKTIK--AP	1891
LANCELET	FPNEIRRSALERVCLPMLRLVHPAALTEFFTD-----HIRE---IMDIIGAPQTK--AG	1885
	.	

Supplementary Figure 4: CLUSTAL All phyla small

APHANOMYCESE	--NDQSPL-ISLVMFAGSLELLYSCLSGDAIR----HSVNPVYA----DAP-AKGNEL-T	1706
FLATWORM	ESETEEIL-LLARGCCRVLSCFYMACGLTELALPRLCDAFKRFYSRQPAAQKDPDRSL-S	1977
STYLONCHIA	DPLEQYQLIKQKKWIFLVEVMFRRLKPETIR----QVHKKLY----GES-SPGNEL-T	1872
TRICHINELLA	QTDCEQQL-ITKIGCYKICAIIYNELDLLECLK----NEVNVSYL---GSDS-QMKNEL-I	1861
HETEROSTELIUM	AIERKSSV-VEKICCFKLQQFYESLPATVIR----DQVNPYFT---GDKHDAKGTTEL-T	2004
GLOMUS	VDEKIYYL-NERAGSLTLLQILYLRASEEDVYSEK-GEIVKAYC---QSRP-LKAKEL-T	1958
MOSS	AEREFEDL-FKKICHYELELLYSKADNVSIT---KTIAPVFT-----SSDL-M	1899
TERMITE	QLQTEHQL-VGRIGAWNILEPLFVHLESSELESKE-CVITAAAF---PGAV-KTGKEL-I	1868
SALPINGOECA	T---PAI-VIKMCTFTLIDILFQRLNNTDLYGKS-AVINKTYCEAAGEPV-NDKGSNLT	1882
ROTIFER	EPAFEMMC-LNKKCVFQILYELAYKRLHKDEIFFTN-AKICMAYETIKFGCV-KDGKEL-T	1872
SHRIMP	D-EQHKTLL-VTKVGSFMILQIMYSKLPREKLFAPG-SEINAAFR---PGD--QSGKEL-T	1885
SCORPION	--SNEIQL-VSKIGAFQLEIILYTYLSKEEVS-KE-SQINCSY-----GKEL-T	1883
SPONGE	DPKLEQQL-VHKSCCFQFIEILYTRLPSLISSEME-STVNTAYC---NGSP-QTGKEL-T	1918
HUMAN	ESTFDTQI-TKKMGYYKILDVMSRLPKDDVHAKE-SKINQVFH---GSCI-TEGNEL-T	1912
ESHARK	ESSFDNQL-TRKIGCYKLEVTYIRLPKDDIYSED-SKINRAFH---SSN-MEGNKLLS	1920
LIMPET	KAELNQL-TTKIGCFQMLLELLYSRLTKDEVNSKN-SVINEKYC---QTKV-ETGKEM-T	1890
LINGULA	ESEIERLL-TLKLCCFELVEVMYSFPKEEVNSKN-SKINLKYC---GGKV-ETGKEM-T	1910
TRICHOPLAX	--DLENQL-ISKLSYKLMKLMYSKLSKQDVNTAE-SSIVKAYT---GRPT-EDGKEI-T	1893
STONYCORAL	DPNFESQV-TSKLCCFKLVEILYSQFSKSELNLTLE-STINKAYV---GGDV-KTGKEL-T	1935
STARFISH	ETVFQNL-VSKTCCFQVELMY SRLVKEDLFSMD-SAINKAYT----NDV-KTGKEM-T	1943
LANCELET	EASLRTQL-TNKLCCFQLETTY SRLPKEEVNTTPP-SRIVRAYK---GEEV-KAGNEM-T	1938
	: : :	
APHANOMYCESE	MRL---CKAASQKSAN-----PENSCAVAAAYRCLLVTVRKT	1739
FLATWORM	NWVSVQCYDLVTQSF-----P--RCRESARQMCEAYNLLVHCIAKAA	2017
STYLONCHIA	KSLIQLCTLAKKAPIDGFVNFVKDSIKSEFPQYN--SPLQVQRQYACAAYTCLTAIIMGT	1930
TRICHINELLA	KKLVSCAVGAKKEFCR-----DSKLDISIQQHFFEYRCAQNCVIALVKKT	1906
HETEROSTELIUM	AAIMKAAHLAKSEKLA-----TDEQHVTRVLATKYHGAAYSALASVVAAT	2049
GLOMUS	KKVMEKAHKIKSRADK-----DDNGNKL--SEANLHFRCEAYNALAAVILCT	2004
MOSS	RQAGDTCHGKLDPEYK-----LYPEN--LSTWRELHAAAYNCLAAVILCT	1942
TERMITE	SDLTSRAYKYRSETLH-----DNLTGNVQL--VELFRSQCAAFNTLVAIISNV	1915
SALPINGOECA	T---NTCRALRDVTV-----GEESL--VELRRQASCAAYNALTVICT	1921
ROTIFER	KEVLRKSRKHMEYVNFN-----TGQESAKIEAN--KDLERILHCSAYNCLISLFIPT	1923
SHRIMP	KEIFRYAAKISKGELR-----HDQTH--AELRRLCACAAYNNAI IAVLACV	1928
SCORPION	REATGFAIAARKENLE-----GESIS--KEFCRKYCCAAYNNAI IAIICCT	1926
SPONGE	QAITKCCCHGAKSEDLH-----GDRTH--YETRRQYHCHAYNTLMSVISCT	1961
HUMAN	KTLIKLCYDAFTENMA-----GENQL--LERRRLYHCAAYNCAISVICCV	1955
ESHARK	KSLKLCYDAFTENMT-----GEKQL--LEKRRQYHCAAYNCIMAVVTCI	1963
LIMPET	QKATKCAHEARSEDTR-----GETEL--VELRRQYHCTAYNLMISISICT	1933
LINGULA	TAVTKAAHEAKKEDVR-----GEKRL--PELRRQYHCAAYNALMAIITCT	1953
TRICHOPLAX	KSITKAAHACKSDDLRL-----GETRS--VELHRQCCCAAYNALISVISST	1936
STONYCORAL	LAI TKAAARAASIEDMR-----GETVA--LELRRQFHCAAYNALVALICCT	1978
STARFISH	QALTKACHAAKSEDIR-----GETNA--LELRRQFHCAAFNALIAIISCT	1986
LANCELET	TAITKFGHAAKSEDLR-----GETGL--LDLRRRFHCAAYNALIAIISCT	1981
	* :	
APHANOMYCESE	QTQEKFYTQLLFADQ-----IWPKIVDQSQDYIFE-TETTSFPTKYLSDARKRTQLR-	1790
FLATWORM	SDKERSYLP-PFTENAARKRF-IFDNIVPTDVDYQLP-LQVEQSASRKQYLVSVRPAAS	2074
STYLONCHIA	QTKENLFSQFLFATLDRKGEECFWNVLIDQEKAYNFE-VETNPNYIQLKQIEFKIEQAN-	1988
TRICHINELLA	QSHLKHYEGLIFND-----CWESIIDEVKYEFD-REIQEEEQSAGKMYYSRQDRPS	1957
HETEROSTELIUM	QTKETTFHVVFVKENKEKNEY-LWENIIDLEQQYNFE-PETNFQISS-----QLSS	2098
GLOMUS	QNNPVFYKAFLEAENTSGEL-LWENIIDLEIHYKIK-IELNQPFRTKVD-DFRSRSRK	2061
MOSS	QIDEKWFNAFLFSEK---SRP-LWQHVLVDTKVYDDMSVETSQSSIIISQTVKGMRADLKA	1998
TERMITE	KCELRFFTGLLFSENKAK-EV-PWGKLVNCKEYALA-LDWEIIPARRKQLVSRQARA	1972
SALPINGOECA	QTQEKFYSAFCFKEATGKVRD-CVFNLIDEKRYTFT-TELPAAMSVRSKCVLALREGEA	1979
ROTIFER	QTEPKLYLAFLEKDDPSKNEF-VFEPKIDIKSYNFC-VEFENFTQRKTKFISIRDEFKV	1981
SHRIMP	QNDLRFYTNFLFSANPTKGEV-IWECLVDCSRNLEFD-VEINFKPAKRRFVAVRQKLE	1986
SCORPION	QTDKSFYSTFLFQENFAKGEY-IWENIIDLNKEYTFP-IELDT-IERRRKFISVRHENRE	1983
SPONGE	QSKPQFVVGFLFKEDVVKQL-LWDNIIDCEKKEYEQ-VDFEAPLKRKQITSIRDDLKQ	2019
HUMAN	FNELKFYQGFLFSEKPEKNLL-IFENLIDLKRRYNFP-VEVEVPMERKKYIEIRKEARE	2013
ESHARK	FTEAKFYQGFLFSEKAENIF-IFENLIEAHRTYNFP-VEIEVPLEKRRFISIRKEARE	2021
LIMPET	FTEAKFYNCFLFSEKPSKQF-LLDNILDEKMFEPK-AELDSPLERKRRFVSIRNEVE	1991
LINGULA	QTEMKFYTGLLFKEDLAGDGF-LLDNIVDQNRKYLFE-IEITSLPQRKRRFVSIRSEAGA	2011
TRICHOPLAX	QTEMKFYTVFLFTENVARQF-LWENLIDMERYAFE-IELSYQDKQKTTFRSLREQSR	1994
STONYCORAL	QTDLKFYVAFLESENPIKQQL-LLDNLVDCNRTYTFE-VELSAPLERKRRKQFRMQRIPSP	2036
STARFISH	QTDIKFYNAFLFSENTAKGQF-LLDNIIDITKNYSFE-IEMNAPMERKRRFVSIRNQIQD	2044
LANCELET	QTDMKFYTAFLFQENTAKGQF-LLDNLVDTNKLYQFD-AEFSAPVSRKQFVSIRQELRG	2039
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Supplementary Figure 4: CLUSTAL All phyla small

APHANOMYCESE	-----QFQRM DISSQFLAGSSLSQSSE----	1812
FLATWORM	ASDSSASEAGPTDDL SWLNPPSSSSTS AVAAGTNSLQFA--ASQFLADSSLSDDVS----	2127
STYLONCHIA	--G-GD-----QIKANNL INEYNEKFNSA	2011
TRICHINELLA	SAE-----YENQV--ELSVLLDSSLSVMAT----	1980
HETEROSTELIUM	AVA-----NSQSRDLKYL--SSQYLQDSSLSQSLD----	2126
GLOMUS	TFK-----EAI VSNLNKYL--ASQYLADSSV TQGGA----	2090
MOSS	RRTRG-----KGSLSQTASTI--SSQYMHSASLSQEP A----	2029
TERMITE	QRR-----ETLGFASQSVRYIPASQYLFDS TLNEDVT----	2005
SALPINGOECA	TPS-----TTAAATAAARRYL--PSQILADSSLSQDAA----	2010
ROTIFER	IKA-DTNSR-----SAN--YISTMHSTSSL--STQNL YSSSLSEELS----	2018
SHRIMP	TAR-EEGA-----VVA-GTVQYM--ASHYLSDS SLSREDMS----	2017
SCORPION	LNS-NKTLN-----FA-----SSLKYA--PSQYLS DSSLSDDVS----	2014
SPONGE	STAAGNSSG-----SPS--SSPSTRPRYI--SSQYLS DSSLSSTDVS----	2056
HUMAN	AAN-GDSDG-----PSYMS--SLSYLADSTLSEEMS----	2041
ESHARK	AGD-GDSGE-----PQYLS--SQSYMADSS LSEEMS----	2049
LIMPET	TRQ-GEEEE-----SL-----FSSYNI--STQNI EESSLSDDL N----	2022
LINGULA	QGD-GNSQD-----SAES-----SVHYL--ASQYLADSS LSEEDVS----	2043
TRICHOPLAX	SVS-SESAD-----EADSGIAMAP--SYHL--SSQYLADSS LNEEIS----	2031
STONYCORAL	-----KEN-----SLEESAGRTGLSIHYM--YSQYLADSS LSEDIS----	2070
STARFISH	TVA-GSSSQ-----QSDSGIEMSGYTGRYL--STQYLANSS LSEDIQ----	2083
LANCELET	QDS-P-----EAG-----SSRY--MQSYLAGSS LSEDIS----	2065

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APHANOMYCESE	-----GEQLS-----SNPTSEET	1825
FLATWORM	-QFDRLVTADLSNTSDSASLATA SLS---LSTSSSFAINQRRSRKNR--FHNQTLTATRR	2181
STYLONCHIA	MVFETQPKIN- IKSEEEKLQKLLNN---KKQ-----NTNQDQ NMLDKSAADEDSEIQ	2060
TRICHINELLA	-QDFFTESLEARTH C-A-----ET-RTESANDKDV MK	2009
HETEROSTELIUM	-VDTSSSTTST-S-----TTTTSNNNL KIVASA	2153
GLOMUS	-LFKELPDESE-GESKNEH-----SDTIPMEI DERNENK	2122
MOSS	-VIRTFVGGIRKEETS AAGV-----GAG---LLLDEESPSTETNIETAEQEEI I	2074
TERMITE	-LFDFTSVVVS-TEARPGH-----DEK-----TPKESGAES	2034
SALPINGOECA	-QLEALRQGADVGESQAVEDASSSSSPSSDGP TFGLDMDASEDSPGAPSNI--PVYVV	2067
ROTIFER	-VDFFSVHSSY-NQ--AYN-----S-----QSSVTRAP SFRRSYTDELNSQE	2057
SHRIMP	-QDFDNNSVVL-AMST E-----SSE-----RVTGANEMGG---VL	2049
SCORPION	-QDFDSSSELA-FSQDMKN-----KNR-----KEEIDSNP SNEAKDDDLVSN	2054
SPONGE	-QYDFTLPHHH-QYGSVGG-----GAST---ESSIDEDSGNSQEA SSV--V	2097
HUMAN	-QDFDSTGVQS-YSYS D-----P-----RPATGRFRRREQRDP-TVHD	2078
ESHARK	-QDFDSTGVQS-FSYNS D-----P-----RGHAVRSR RKEQAE LSVVQS	2087
LIMPET	-QYDFNSGTAQ-VFFSDIF-----SDL-----TSSSNVQP DQFN TTV	2057
LINGULA	-AYDYSGLSQG-ERSEPV P-----P-----RTRQR--AVSEEA VPAEA	2078
TRICHOPLAX	-QDFDNSSVTQ-GYSENN S-----IKQIPT-----RETGDSEKAKTI INKF	2070
STONYCORAL	-QCFDSSPIQV-HSGTEAR-----QPLYKLN ESSSTA---EQTDDWYEV--	2109
STARFISH	-QDFDFSGGVQO-FNASIDK-----DQSLSQRSSVPH I KKRY SNEETPTVVVQG	2129
LANCELET	-QDFDTSGTQV-KHSQTF S-----STQERYSQASQGS S RLQARQQDSSVNIHG	2112

S2056

APHANOMYCESE	EDEVLELDILNMHPCMIPLMQTIKHMETLFHSQW-----SN--TAMPGWIEKVVFN L	1875
FLATWORM	NLIVLES DSVNDHPCMATMVALLRHMKAFKLIPQ---LPEGVKP--TQMPKWMQNLQKV	2236
STYLONCHIA	DVSQLELDNVNKHCEMKNIKRCIDKMSL FFKREW-----DQNT--NEMPKFMQNL CLEI	2112
TRICHINELLA	FYSKTKLDDLQHPCMQAMVNVINYMDHMG MIPY-----EAGTLP AWMASMRD FL	2060
HETEROSTELIUM	MNMP IELDKINSNPSMQMLKIIDIYQERFRESI-----DQSP--NDMPKWMNELYLKV	2205
GLOMUS	SKLELEIDVFN SHPCMKMIIRVIDRLH SQLTKPV-----DPVESMPGWMNDIYK KF	2173
MOSS	ETTALDRDDFDQHCEMPVILRLAEHVHVKFGA-----NYQP--GVMPDWMKSLHATL	2124
TERMITE	TEVILESDDLNMHECMATLCGVIEHMVDQGISPTDA---ETKD--AALP P WESMRKCL	2089
SALPINGOECA	EDSQEMDELNSHESMVS LMGLIQRIQAVHAESKPQRNEDGLILPSSTMP SWM SNLLKSF	2127
ROTIFER	QSVEI ELDELNQHE SMDNLISL FQSLVKNITPI---YDNGQLP--SEMP P WMTFVHKKI	2112
SHRIMP	MPVHMDQSDYNGHEVMANLTAVINHMVDAEIMVL---HKGDTVPKATDVPQWMTLVQQKL	2106
SCORPION	ITVELEIDDLNQHECMNSL TMLVQHMEKIQLL-----SSSP--KEIPKWL DNLCKKL	2104
SPONGE	SEEQLEEDDLNIHECM TPLMKLLDHMIINKITPA---PSGD--S--PEMP P WMTPLHKRM	2150
HUMAN	DVLELEMDDELNRHECMAPLTALVKHMHRSLGPPQ---GEEDSVP--RDL P SWMKFLHGKL	2133
ESHARK	DIMELEMDDELNQHECM PAMIALINHMQRN NITPQ---VEEGKTP--QELP P WMKFLHGKL	2142
LIMPET	DYIELEDELNQHECMATMV ALIKHLHT--VITP---VLKGTIP--KEMPTWMSYFSEKM	2110
LINGULA	DYEEIEMDELNQHECM TALLKHMQRNKITPD---VVS--NP--LDV P P WMKYLRDKM	2131
TRICHOPLAX	ADELELDLNLKHECM EALLTLLDHMAVNKINPA---IEKDTTP--SEMP SWMVALRKA	2125
STONYCORAL	SEDTLEMDDLNRHESMAK MISLLKHLVDKKISPE---QVKDVPP--TDM P AWMAPLHKKI	2164
STARFISH	EYIEMESDALNQHECMASLTAVLKHMQANKITPE---IPEGSKA--SEMPGW MASLQKKL	2184
LANCELET	DFLEIEMDELNQHECMSSSAVLQHMARN NITPQ---VQKGAAP--KDM P P WMSCLNKKL	2167

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Supplementary Figure 4: CLUSTAL All phyla small

APHANOMYCESE	SS-----HSSTATRIFLCKLVVNRPGIFEPYAAKFVGPVIVELIVEV-----	1916
FLATWORM	SN-----SSTDSHPNVRIFLMKLLINQCQDIFQPYAHFWLRPMCQFALS---DR-----	2281
STYLONCHIA	KR-----PDIHLNFKIFILKILINHPQLFSAYAKEWFEPYIANYLCD-----KN-----	2155
TRICHINELLA	NF-----GSINVRFLFIARIIVQCFHFVRFPFYLEWISPIIKLIVM---DE-----	2101
HETEROSTELIUM	KN-----DTNLHPNILIFILKVIINRQQYFYRYHKQWTPILIEYVIS---NQ-----	2249
GLOMUS	TNIGNENKENDTHINIRLFIAKIIVNVPEAFEKYASLWIRPVIKLIIE---GR-----	2223
MOSS	DN-----AATHINVRFLAKVITKTRKIFAPHAADWIRPYVQTILIDPRK-----	2169
TERMITE	SD-----YSQPRNIRLFLKLIILNVESEKHPYAHHMNSILKAITD---G-----	2131
SALPINGOECA	ES-----TSTSHNVRLFIAKLITNMPDAFQWSSRWLRPIMLLILKFQDE-----	2172
ROTIFER	LD-----VYTHENIKLFIARAIANTESIFKPYCKFWYSALIGFLVNSSLC-----	2157
SHRIMP	DS-----ADTPRNVKLFLLRVMNNARIIFEPYAAHFVSTILTCLVD---G-----	2148
SCORPION	ED-----YSVHRNIKLFITKLFINNAEIFKPYAVFLLQPLINLILN---A-----	2146
SPONGE	TD-----SRTGRNIKLFIVRLITNRPKIFQPYAKHWLPVLTQFILSGDSTAGMGGAVG	2203
HUMAN	GN-----PIVPLNIRLFLAKLIVNTEEVFRPYAKHWLSPLLQLAAS---EN-----	2176
ESHARK	GN-----SSIPLNIRLFIAKLIVNSEVFRPYAKEWLGPLLQLVVS---GN-----	2185
LIMPET	TN-----PATSFNIKLFARLIFNTSEVFPQYTKFWLRPLCQLIFS---GP-----	2153
LINGULA	ND-----TTHINVKLFIAKLILNAEVEFAPYAKFWLGPLVQLMVR---D-----	2173
TRICHOPLAX	SD-----HTTNRNIKLFIAKLIINRPKIFRPYAKFWLVPLIQLIVE---G-----	2167
STONYCORAL	AS-----SSTHLNIRLFIAKLILINEAKIFEAHAKFWFNPLMELILQIKDTEP-----	2211
STARFISH	TS-----QSTHVNIKLFARLIINNNEVFTPYARFWLSGLLQLLIS---GN-----	2227
LANCELET	GG-----SSTHKNVKLFLAKLIVNNEEVFRPYARFWLSPLMEMIVR---GE-----	2210
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APHANOMYCESE	PKLDEFHYILRDIICHLVVDTWHLETIDYD-----LSQFVKHLIAVSPNTSAAIL	1965
FLATWORM	NGGQGFHTLLVDIVYFV--SWGTAIPEDD---LGDRLDVERLLDKLTGLCYDKERRIF	2336
STYLONCHIA	NGGKGFHYFMRDLCTLLI--AWN--IPEDN---TKNRLCTNVVNTLIKYSADTKMIF	2208
TRICHINELLA	FGSNILHYFRVDLIVVLF--EWTAKLKEDE---AIPKDSLNDLLKFCVKHCWSKSGKVF	2155
HETEROSTELIUM	TGGQGIHYFIRDIAMLL--SWPNYQDQKLDQLDLSKSNISKFINFLIQNSYCADRQIL	2308
GLOMUS	SYGEGINYFIQDLCAIVT--VWGSFITLE--S---YQDKVLIYELMEFLMKNSYNESRIVI	2277
MOSS	SGGLKFHYMLRDICTVIL--QNVVASADG-----RLATNFVHHLISVADHGNSQVL	2219
TERMITE	VVGRAPNYLLSDTVAMLA--DWCRKTTSLPA---KSDHHLVSQQLYLLISKVHHDRRDVF	2186
SALPINGOECA	PETPGFNYFVTDLCLLL--TWADTAVPQDD---SE--KRLARQLVQFLMENARHETTAVF	2226
ROTIFER	RDLAQMDCFITLDMVMML--SWGSIQKPDQS---E--AKLINRFLITLLIKRCYHENRAVL	2210
SHRIMP	TIGDKINYFFCDVMVMVM--GWGSKAVPQDT---VMGRNIVGRVLRYLCMNTPQTRADIF	2203
SCORPION	TFGREINYFILDLMVVL--SWSSIAIPEDS---SIGRHAASGLEFLMSKCFHIRKDFV	2201
SPONGE	GGENGLDYFTVDAIATML--SWSSTAIIED-----RFLGSQLEIYMLRSNHKNRSIL	2254
HUMAN	NGGEGIHYMVVEIVATIL--SWTGLATPTGV---PKDEVLANRLLNFLMKHVFHFKRAVF	2231
ESHARK	NGGDGIHYMVVEIVVTVL--SWTSVATPKGN---MKDEILANRLEFLMKNSFHEKTAVF	2240
LIMPET	LSSDGINYNVDLIVMM--SWHTTSIPQDT---AEERAMSSRLVQFLMANIYHKNKQIY	2208
LINGULA	MPDEGLNYVVDIMVTVL--SWSSVAVPQDT---AMDRAMASRLVEFVVRNVNHDTRQIF	2228
TRICHOPLAX	KESDGIHYFIVDLMIILL--SWADVAIPKDV---DE--ILQANRLEFLMRNAFYPNRSIF	2221
STONYCORAL	AGTEGINYNFIVDLVVTLL--SWSTAIIPEDS---HNDRHASRLGFLMSRTRHRHRSLF	2266
STARFISH	TGGEGIHYMVVDVVVVL--GWVTVAIPEDK---RL---ANRLEFLMHFCHHSNRQVL	2278
LANCELET	ASGEGINYFIVDLLVTML--SWGVAIPEDS---AMGRALTSRLLHFLMANAFHKTRAVM	2265
	. : . . * . . :	
APHANOMYCESE	RDNLYLIESFLFRYPSQC--RFLNGDAIMDMIGGDG--N---DKLDTARHVAGMQIVAMLL	2019
FLATWORM	KNNWRLLDALIRSWRSRV--HCVPYKRIFDQLQ--Q-----TEEYTAAGLQLYNAYL	2386
STYLONCHIA	NTNIEIAGLLHRWKKLV--AINKDVISMIMIGMD--K---KPESNLWKMTGIQILALAV	2261
TRICHINELLA	KRNLRIETMLVLWKSFV--TLDPSLILEKICFPL-----GNE--NENVCGISILCLCL	2205
HETEROSTELIUM	RNNLNILKLFVERWGLF--SVEKKSIVEALATPV--TNFKSKAR--QVRSTALIQLSILL	2363
GLOMUS	RNNILIIKAIFEIWSELI--VVPTHVHELFSDSV-----GNV--DKVYTGQLLGVVL	2327
MOSS	RANIDIIRLFLENWKGSI--SLERQQLQYLSISGRNPDMDNRNIKMKRLVGLQLLGAV	2277
TERMITE	KHNLELIRTVVELWKNPF--DIPVQLLYDMIM--K--H---DRKDPTVSEPGIQVAAIIL	2237
SALPINGOECA	KNNVNIIRLLERWKDAVQDKVPFKVIVDNMS--S--R---QMAS--KDNLSGLHLLSLIL	2278
ROTIFER	KNNIELIKTMTECWDRMI--QVPVELINNFLT--S--N---DH---RKLSTGIQLFGVVL	2258
SHRIMP	KYNLDVVRVVECWKSL--TVPYTVIYSLME--V--K---DGAE--REVEAGLQLLGIIL	2253
SCORPION	RNNLEMIKTVVQCWKERL--DIPYIIFESMR--N--L---DTKV--KDNIVGIQLFGIVV	2251
SPONGE	RNNLEIVRTMVELWKDKI--DIPTRVLYDQFS--N--S---DKST--VSNLSGIQLVGIAV	2304
HUMAN	RHNLEIIKTLVECWKDC--SIPYRILIFEKFS--G--K---DPNS--KDNVSGIQLLGIVM	2281
ESHARK	RHNLEIIKTVVECWKDC--SVPYSLIFSRFS--S--T---DPNS--KDNVSGIQLLGIIV	2290
LIMPET	RNNLEMLKTVLECWHDRI--EIPYKIYYNQLK--S--E-----ENKSVGIQLLGVVI	2254
LINGULA	RNNLELLKTLVECWKGRF--DMPYKIYYNFS--D--R---DPKS--KTNTAGVQMGVFL	2278
TRICHOPLAX	RNNIEIIKTAVELWKNHI--EIPYRIYYKNS--N--P---DKDK--KDNSTGIQCLGLVV	2271
STONYCORAL	RNNLEIVKSVVEIWKSI--HVPAAEVIFNFS--D--P---DPVK--KDNVSGIQLLGVVV	2316
STARFISH	RNNLEMIKTVECWKEII--SVPTSVIYRILA--T--P---DPDV--KDSSTGLQLLGIIV	2328
LANCELET	RNNLELIKTAVECWKTRV--EVPYTKVYHDLG--G--S---DASS--KANSVGIQLLGVVL	2315
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Supplementary Figure 4: CLUSTAL All phyla small

APHANOMYCESE	SLAFDATSPATSFE-----FLLR--NAR---AKLENNLLTRMV--SMHKTTPILAADI	2065
FLATWORM	SNALPYFNEQQGVNVGGVDS-----PQILAAALVRLLN--HSRKEVYSPCAGV	2431
STYLOMCHIA	SFDLIVIEKPENIGQTNVNRQREFRFQEQNENQLGDKLMNSLLKILE--SKKKQIQAASET	2320
TRICHINELLA	NTVPETFSFLTD-----PNYE-----SGIFSHLVRLLS--LKNVKLFKLAAFV	2246
HETEROSTELIUM	SNGYAAAYDKEND---SEISE-----FKFYQLIDCLT--EYKELYDAASEI	2404
GLOMUS	AHDKPLFQDEVGLDLGGLTS-----DKFYMDLTNNLLNHVNSNVRALAAEV	2373
MOSS	GGIPIYDPSCD---FSTSE-----EHICEALLNLLN--VKTKEVYEAAL	2319
TERMITE	ANRLEPWSST-----GK-----LQFLRALLRNID--TEKRSIFQSSAEV	2274
SALPINGOECA	ANDMMPSESDVE--EAGLSM-----RSFFQLVANLM--FKRSRVYRTAAEV	2321
ROTIFER	SNGIENYEYP---MDISR-----LDFFKSLINCIK--EPSKLIHAPAAEV	2298
SHRIMP	ANGLPPYTVD---SETEK-----KRCESLVIRLLG--AHYASVYGAAAEV	2293
SCORPION	SNGLDPYQNT---SRIDK-----ISYLKTLTVNLK--NKYKEIYESASEV	2291
SPONGE	ANELNYPDTNTA---GSLDQ-----GLYYKIFVNNLT--FKYKLIYAAAEEV	2346
HUMAN	ANLPPYDPQ---CGIQS-----SEYFQALVNNMSFVRYKEVYAAAAEV	2322
ESHARK	ANLSPYVVK---CEIGY-----ERYFQRLVYNI--SLTRYKEVYAAAAEV	2331
LIMPET	TCKFPYVGPD---CPVDR-----HKFFTVAFLMC--DKSKPVYATGEV	2294
LINGULA	ANGLPAYSYT---SEVDR-----EKFYKALASNMG--SYWKTSSAAAEEV	2318
TRICHOPLAX	ANGLSPYRYDV---EVDE-----MLALAENLQ--FKYKEVYEAVAEV	2308
STONYCORAL	ANGLFPVTS---STIDE-----DRFYGLTVNNLT--FKYKDVHAAAEEV	2356
STARFISH	ANGLHPIDKA---SDIDE-----ERFYAALSYNLK--NRYKMVHAAAEEV	2368
LANCELET	ANQLPPFPNSTS---GNIDR-----EQFFSAVAKNLQLTRYKDVYAAAAEV	2358
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APHANOMYCESE	AGLVLKHMHSTTF-----QTSVETQLALFFQ----EKPDRFLTVCVKQ---VSFHYP	2110
FLATWORM	TGLYLRQMVAQS--V-VPAFYKQVAEQLGKML-----TARPDAGLHALAQ---VSRCCP	2480
STYLOMCHIA	LKILNKQPSLVA-----QSIHPLMNN--EITERHDFVHVSIEK---ITREYP	2363
TRICHINELLA	CGLSLKVLNELQT--D-----CEWLLKNMKAVMSRMTGTMGRSKCLFCLHE---ILPNYP	2297
HETEROSTELIUM	CGMILQFNHKKHNI---QSVFEKLLKDKISSFLS----QSDYQRALNCLYF---IGLHHP	2453
GLOMUS	CGLAVKHLRKYHCSEALSLLNPLMKISGMYYQALSNESDMKNFLTIVH--ISMHDV	2430
MOSS	VGITMIYRKESRQ--VNEEILEAKLHKILKQLYR----EAAYERFLNINLN---ITIRHP	2370
TERMITE	AGMALELLAANGSGMLEGDDAEFLSGIVDKLNL---TKDQSKDKFLTCLFA---VQEEYP	2328
SALPINGOECA	TGMLLSHFKSKGRRLLELMNEVVVARLDQLKDD--DDATSKERLITCLHELNVNTGHP	2379
ROTIFER	VGMLLKRFDSDHK--EYFENTVS---HLFEILR-----EADTSLFITSIHK---IQLNYA	2345
SHRIMP	MGLLKYTSQKDG--SVEA--LEDAVVKRVTELT-----VKMQGQLTCLYIN---IHKHYP	2342
SCORPION	CGMSMKYFDPKDD--DVYSEFKIVKTEISSLN-----AKDQYLTCLYK---INTHFP	2339
SPONGE	LGMTMKRMAESYD--PFLDRLEEMVGEQLFKLSQ---PLEKSEDKFITCLHK---ITLCYN	2399
HUMAN	LGLILRYVMERKN--ILEESLCELVAKQLKQHQ-----NTMEDKFIIVCLNK---VTKSFP	2372
ESHARK	LGLVLHYFAENEK--QVDGLVHDLIAKELKQLQ-----QSKEDKFIIVCLSK---IVKNYP	2381
LIMPET	VGMIKYLEVKEQ--ETEGEFHYYIINNISSLQ-----LSKPDNFICYIHK---IHQYYP	2344
LINGULA	VGMLQDLDQHDK--DFKEEYVNHLSVLSLQ-----QSNPDTYMLCVYK---MHLHK	2368
TRICHOPLAX	LGMIMKHLASVKK--ETEGPIFDYVTQHLSSMVS---AGRMDVARFILCLYR---VOLHYP	2361
STONYCORAL	IGLLMMQLAKVKK--IFDGPLHDMVGQKLSLVN---RAKPELDKFITCVHK---LKLNYP	2409
STARFISH	IGMAMKQKADVVK--VTDGFLHSIVTSELTKIS-----EIKPDVFVTCIHK---LHFHYP	2418
LANCELET	IGMTMKYMADVEK--VTEGSFHTQVERYLLPLQ-----VNQDVFVLTVCVHK---IHLHFP	2408
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APHANOMYCESE	PIVD--ESTLNRMSIFPRIWQDITLLCTLDIVYSSNFQA-----AEIFR--FLRPH	2159
FLATWORM	RLAC--IEFRQRLLFQPLHGTGDSLA--D-CLVCLAAAATAAAVSDNCRWPNAAVELKERG	2537
STYLOMCHIA	ELLIDRKIFMKLLSFVKTLTGSMRA--S--ILKSFERFINVCRQRKKIEDINEIAMSLADS	2421
TRICHINELLA	EFAL--QFCNDLLDWFPSSLHGLDKT--A-CLEGFAVSKYK-----GDFFEELKSRG	2344
HETEROSTELIUM	SFIL--QFQLKLLNILPQLSNEIRL--V-AFNVIYWIADDI-----PELFIKLKSAN	2500
GLOMUS	DVAV--RFLKYVFGILPRLN--KI-L-ALEIISFCAGHD-----PDLFTNLQRDR	2476
MOSS	GFLE--GYAEMVVDQLSRFLGAYKV--N-ALDTLRFPKAD-----ANLFPN--ISRS	2416
TERMITE	RIVD--AFMNHVLFHLPKTYGIFRT--M-CLKIVYSRLEILG-----DTYAEMKSEN	2376
SALPINGOECA	PVVD--HFVQRLLFLAPSLPGQFKT--M-ALETLLWRAEDI-----PDLFRELQKKG	2426
ROTIFER	AISE--RFMTKLVFFLPQLYGDFKK--M-CAESILSSIRVL-----QDPL--FKSEN	2390
SHRIMP	SFVK--RLINKLLNLPKLYGIHRK--N-VLECLIAHSATM-----EDIYHLHKEQN	2389
SCORPION	IFID--SSFLENKILYMLPNVHGIFRK--Q-ILEIINSHVENI-----ENAFIELKNOG	2387
SPONGE	KIVP--RFVEKLLFLLPSLQGVFRS--S-CLEILDTQADVQ-----POFYLLKLDKG	2446
HUMAN	PLAD--RFNAVVFLLPKFHGVLKT--L-CLEVLCRVEGM-----TELYFQLKSKD	2419
ESHARK	PFAD--RRFLNQVYFLLPKLHGVLKT--H-CLEVVMHRAETI-----IDIFQELKNKN	2429
LIMPET	PTAD--RLLNKLLFMLPNLNGESRR--L-CLEVHGRIGQI-----DNVFMELKTRG	2391
LINGULA	PIAE--RFMKNLLFMLPRLHGEYKR--H-CLEVISSRVQNM-----ENAFIELKKNKG	2415
TRICHOPLAX	IAD--RFVNVKLVFLMPSLYGEFKT--K-CLEIILARADHI-----KELYTELNRNG	2408
STONYCORAL	PIVD--RFVNQILFTLPSVHGDFKS--Y-CLEILCSRVEHI-----PNLFTELKGRG	2456
STARFISH	EFAD--HFTNKLFLMPLSLHGQPKT--L-CLEVVASRVSHI-----PNIFLEMKSKG	2465
LANCELET	PFAD--RFVSKLLFMLPKLHGIFRT--H-CLEVIIRGRVNI-----DNLFLLELKTRN	2455
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Supplementary Figure 4: CLUSTAL All phyla small

APHANOMYCESE	LPRLLRHNNPDVP-----LRLIDVMTKLPNLSLSED-----YQMV----	2193
FLATWORM	FFDSLKRLFALSSGGASVSAESRVPQNSLALCERLLLLLQQERLADAEQAAIKQQRVW	2597
STYLONCHIA	EEILADISDENQQ-----SFLILITQIAKLNLDTG-----DKLMQR----	2457
TRICHINELLA	FLKVFSLRYERDQ-----MLGMYIVKNLHANLTVL-----NISD----	2378
HETEROSTELIUM	LDSLIRIREEQTQ-----IIILKILFKLIKNNYTT-----DQTLQLQI----	2537
GLOMUS	LLGFLKHRDENEQ-----LLALRILAGILQEIEVS-----TFEY----	2510
MOSS	LPKLLAHRDEIAQ-----LKLQLLSQLLKNVNDQ-----TIRTR----	2451
TERMITE	LFKTSLDRDPDQ-----NLALSIVHKMVPHLKPE-----QLEE----	2410
SALPINGOECA	LLSLIKHHHTETQ-----AVVLSILKVLVLLHHLNAS-----SIKQ----	2460
ROTIFER	FIDMLTHRDTPIQ-----LICKMIHETLDKQTDL-----DLDR----	2424
SHRIMP	LLDILAKKEASTQ-----LVALQLVNAVMPRLTPS-----QLLY----	2423
SCORPION	LLNMLEHRDESIQ-----FSSLNIIQKLLKELDID-----KMLN----	2421
SPONGE	FHTMISHRDEATQ-----TASLDSIVQKLLVQLTND-----QLSE----	2480
HUMAN	FVQVMRHRDDERQ-----KVCLDIIYKMPKLPV-----ELRE-----	2453
ESHARK	FVQIMRSYSDEERQ-----RICLDIVYKIIAKLKAEL-----EVKV----	2463
LIMPET	LLSFLTQRNEKTQ-----LVALNIIITSIREKLLKSK-----EMSS----	2425
LINGULA	LLTMLTHRDDSTQ-----AVCLKIVNELLRRLQPD-----EVLV----	2449
TRICHOPLAX	LKDMLLHRDESKQ-----QVSLDLVRAMLKNLDIS-----QILY----	2442
STONYCORAL	LKEMLSQRDDGIQ-----IGVLRRIKHLMKKLTIP-----ELKF----	2490
STARFISH	IVELLTHRDEGTQ-----LVSLKLVNAMLPNLKPD-----ELLY----	2499
LANCELET	FLGLMLTHRDDGLQ-----AIVLQIVYALLQKLVKVE-----ELLY----	2489
	: :	
APHANOMYCESE	LLSGD-----CSVLFAPENESCQMKVLQFVISIDKL-S-----	2225
FLATWORM	LLAAVGMCLASTGAGAGSVAALTLPAARRQAYQILATWYPTHP-----	2641
STYLONCHIA	VLPRLL-----KQLFQHNKNDYSRGLFYDLMVYLYDQFENFK-----	2493
TRICHINELLA	LVSS-----FSSVIGNFSPSCRRFAEMCCSLYTKLSSLND-----SSEN	2418
HETEROSTELIUM	INLLL-----DCRFNQSPNETCRLLYYDIFMWIHDYLEKDDVID-----	2575
GLOMUS	YLDGL-----IESFQDHPNNDCCRRTYITLVKMYNKINGT-----	2545
MOSS	VLPVL-----CDNFNGHENVDCCRREFYELIYLFKKNKGMK-----	2487
TERMITE	LVHE-----ICKFETQRSVKCRSVMYELIKWYDHCQDIG-----	2445
SALPINGOECA	FLPSV-----TANCCSHDDYTVRAIAYDILMAVYDQKLSHERGDVVLADDETA	2509
ROTIFER	LMPH-----LEKFIHHPHLSCRYQFVLLILISLEYIYQFKVN-----QIGS	2464
SHRIMP	FMPG-----VAFASHPAPSCRETMYDVLFWVYDNFSNND-----TED	2461
SCORPION	VFPF-----ISKVHKSAEITCRKVMYELIMMHAYEKFNTPK-----GK	2459
SPONGE	IVPIL-----IASFSKHGSIQCRIVLVNILMRVYNKLCITDDQSE-----SDDS	2523
HUMAN	LLNP-----VVEFVSHPSTTCREQMYNILLMWIHDNYRDE-SE-----TDND	2494
ESHARK	FLVP-----VIAFISHPSPVCRERMYDILMWIYDNYRDAE-SQ-----SDPD	2504
LIMPET	LMDS-----ITAFSHHPSTLCRKVMFELLMWYDNYREDE-----CTE	2463
LINGULA	FLPA-----VTAFSSSPMPCRGLMYDILMWIYDNYRDEN-----NAT	2487
TRICHOPLAX	LAEL-----VATFKTNPSAACRQKMYGIFMWIYDTFRQEIHK-----NDE	2482
STONYCORAL	IFPL-----LTSFVSHPNLLCRDLMYDIFIWIYDSYRADEAFQ-----AEEG	2532
STARFISH	LLPP-----VRTVFNLPSACREVMYDILMWIYDNFRDEE-SR-----TEDG	2540
LANCELET	LLPS-----VAAFASHPAPECCRRRTMYDILMMWYDNYREEA-SQ-----QE-S	2529
	: :	
APHANOMYCESE	----VPAVQLISLKALESSRIADVREAYEFWEK--QL-PSSCHDRLLALFGPLYHDQTT	2278
FLATWORM	----NLCAPALLAGLTDSAESNRAWLLEFWSRNSGL-PSEASARWFALLSRCHGNNTAD	2695
STYLONCHIA	----PLVKSALIRGLSDKTKVVRNKLISFWSDSRRL-GLDPNQRLLQIMNDLYTQEEEN	2547
TRICHINELLA	SKAALATTKMHLTMLS DNSKSI RQLVYNFWCDASRL-EISTSARLLNCLSQLYTCATES	2477
HETEROSTELIUM	----QNQIRLTLLIGLSDDSEAVKRKLEFWDTSKEL-SLSTVQRLMQLFEKMYTKETES	2630
GLOMUS	-VEIKHKLKINLLRGLIDTDESIQQALIEFWHAQEEL-SHNTFTKLLKELIGNLYSTES	2603
MOSS	----ERLVIQSLLMGLCDSSDIVRASLQNFVHLQLS--QDVRHRFLELVNRIYDPCLEE	2540
TERMITE	-GVLIEEAKGILLKGLRDDPHLQDSIFEYWNDAQQRDASTSDRLLFILTLDLYCPATEH	2504
SALPINGOECA	LTEIAQLARTHLLLGLQDSSPKLRQSIVAYWDQEKRL-ARNPVQRFYDGLTSLYVPEAEE	2568
ROTIFER	TSQILLNFSKENLLKALIDEEDTSIRVMAQNFWTEKADM-PSNTIDRMLLIVEKLYSPKTER	2523
SHRIMP	GHQLESQARGVLLRAVKEEDAALRQIVLNFWLQGARS-MTLT-QCLLHILRKMYSPESED	2519
SCORPION	EKEISRYAKEMLLHGLADSDLTLRLTVHNFWSQNNHL-PAETFSRKAVLQKMYSPIEH	2518
SPONGE	VKMIRSISRQDLLGLGDESNEVKLKMYYEYWNQESNL-SSNTLDRLTQLLVTLYSKKTET	2582
HUMAN	SQEIFKLAQDVLIQGLIDENPGLQLIRNFWSHETRL-PSNTLDRLLA-LNSLYSPKIEV	2552
ESHARK	SKAVFVTTKDTLLQGLTDDNPALQLYVRNFVGHENRL-PGTGTHDRMLAIRSMYSNKIET	2563
LIMPET	GHEIMLKTKCELLKGLGDEDMCRLLVQNFVSSDTRL-PGTGLDRMVAMLEAMYSPSETQ	2522
LINGULA	VHQIMSRTKDALLNGMSDKDLGLRLRVMNFWSHESRL-PAGTLERMVAMLEAMYSPSVES	2546
TRICHOPLAX	TKQLINFCKDQLLQGLNDSSEENRLQLLNFWSNNRRL-PSGTLERLSSVLYALYSPNAES	2541
STONYCORAL	SADILADAKDHLLQGLADDHRDLQLKLRNFWSDEARL-PGTTLERLVEVLRALYSTTTEI	2591
STARFISH	ADDILCMARDTLQGLSDEEASHRLRVSNFWSHETRL-PGTGLERLVMLECMYSPGTEH	2599
LANCELET	AGRVLGTAKDCLLQGLSDEESYLRLLVQNFWSHETRL-PGTGLERLVMLECMHSPRTEP	2588
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Supplementary Figure 4: CLUSTAL All phyla small

APHANOMYCESE	DW-----	-----VKYAPKLWLSLQASSDN	2298
FLATWORM	EDSNRDEEFSAS-----	-----TGAVLPAFCSAVQLDACSSTPDF	2730
STYLONCHIA	IW-----	-----LNNSVFLLMQICSQSSDF	2567
TRICHINELLA	TF-----	-----LSHASYVMLELTCHSPDY	2497
HETEROSTELIUM	QW-----	-----LYCCSLLQLCTRSSDF	2650
GLOMUS	LF-----	-----LNYACYLLEGSKKSIEY	2623
MOSS	NW-----	-----AQISNVLLKLCEDSVDY	2560
TERMITE	IF-----	-----LGYSTQYLEATAGTPDY	2524
SALPINGOECA	AY-----	-----LQFVTNVMLQLTKHSPDY	2588
ROTIFER	EF-----	-----LSYSTNLLLEKTSKSPDY	2543
SHRIMP	SF-----	-----LQMAIYVLEATHRSADY	2539
SCORPION	MFS-SDECFPLYISLIVDNFWSNEKRLPLGTVERLIALMKNMLQYSTFLLMEMTSKSPDY		2577
SPONGE	QF-----	-----LYHATNLLLELTSRSPDY	2602
HUMAN	HF-----	-----LSLATNFFLEMTSMSPDY	2572
ESHARK	QY-----	-----LSIATNLLLEMTSRSPDY	2583
LIMPET	QY-----	-----LSYATNLLLEMTTKSPDY	2542
LINGULA	SY-----	-----LSYATNFILEMTSKSPDY	2566
TRICHOPLAX	EF-----	-----LSYSTNLLLELTSRSPDY	2561
STONYCORAL	QY-----	-----LSYTTNLLLHLSLSPDY	2611
STARFISH	QY-----	-----LSYASSLLEMTSKSPDY	2619
LANCELET	QY-----	-----LSYCTNLLLEMTSRSPDF	2608
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APHANOMYCESE	KQFLFSEPLSSSANFEQLA-IDTS--WEHRTQNILTPLFSD-----	-----AQALQSQS---	2345
FLATWORM	RRPMFDRPLADCPFR-ECR-IDAD--WRRRHGGLMTPLFLET-----	-----QOQQQQQKASD	2779
STYLONCHIA	NRKIFDAPLQDCKFQ-PL-INOFGHQLNRSQPL-TPLLSQMDQIFQASQMQAKDQQLGV		2624
TRICHINELLA	TRLIYDHPLEDCTFE-NLP-ISTH--WQSRYASLEVPAYMQT-----	-----DMHSEVSKFIS	2546
HETEROSTELIUM	TKLLFDKPLSECTFR-EYN-LDAS--WQNRTSNM-NPLFSSS-----	-----QLDEESSQLPT	2698
GLOMUS	NKPIFDQQLPQSRFDENYDDIDTS--WRVNN-TM-TPLFINT-----	-----QTSKQKGNL--	2670
MOSS	KRPIFSAPLSECVFQ-DYT-INTS--WVGASLPM-TPLFSSS-----	-----QMSMDIQGMHG	2608
TERMITE	NQKIFKEPLQKQCFE-DFR-MLLS--WRAQNATV-APMFADT-----	-----LASQLIQTS-	2571
SALPINGOECA	DRELFARPLSSSTWR-NYR-VDAS--WRQRNAHM-TPLFAAT-----	-----QSQASAGEGE	2636
ROTIFER	NRLIYENPLSECIFR-EYN-LSAD--WRRRHEIM-TPLFAET-----	-----VTNTFTES---	2588
SHRIMP	QRNIFDQPLTECKFR-EMK-VSTA--WRARHAM-IPMFAET-----	-----QASNDTSLNSL	2587
SCORPION	NLKIYQNPSTCAFQ-NYA-ISSS--WKKRHATL-TPWVDS-----	-----LSSAASFSDT-	2624
SPONGE	NRVLFDTPLSECRFE-DYKEIDLS--WQQRHLQM-TPLFAAT-----	-----QLSQTSQSDTG-	2650
HUMAN	PNPMFEHPLSECFEQ-EYT-IDSD--WRFSTVL-TPMFVET-----	-----QASQGLQTRT	2620
ESHARK	TREMFHEYPLSECKFQ-DYN-IDSS--WQQRSTIL-TPMFVET-----	-----QATQNSRSQS	2631
LIMPET	QREIFEHPLSECRFQ-EFS-VKSS--WKQRHAAM-TPLFAAT-----	-----ISTVSESME-	2588
LINGULA	NREIFEHPLDDCPFE-DFV-VRSS--WKQRHAAM-TPLFAET-----	-----QFSLADGTQSG	2614
TRICHOPLAX	KLSIFDHPLESECKFH-DYN-VNYS--WQYRHAM-TPLFAAT-----	-----QLGSGQSMAS-	2608
STONYCORAL	ERLMFEQPLSECRFE-EYQ-IDYS--WQRRHLAM-TPLFAAT-----	-----QSGHSGGMTPT	2659
STARFISH	KREIFEHPLSECRFQ-DVT-IDHS--WKQRHLAISTPMFVET-----	-----QSSQASSGS-Q	2667
LANCELET	SREIFQHPLSECRFQ-DVQ-IDHS--WKQRHVAM-TPMFVET-----	-----QSSHPASSQSQ	2656
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APHANOMYCESE	-----	-----AIFEGGFV	2353
FLATWORM	VEP---GTLRQLQDGDG-----	-----ATAAVAMGTDASMLPLRATAVGPGMF	2819
STYLONCHIA	IKEVQENPNDENIAGDVTMIDTTVSNSNRNQRRPQIQASQIGSQSVVEISDTQAQDGNFV		2684
TRICHINELLA	-----	-----RKRKMPYGR	2555
HETEROSTELIUM	F-----	-----DGDNFGP	2706
GLOMUS	-----	-----KRQEGLV	2677
MOSS	E-D-----	-----RD-----GEFDGATHHRPMMI	2626
TERMITE	-----	-----LSGTGEHTGAGPLL	2585
SALPINGOECA	-----	-----GEDEDFSGV	2645
ROTIFER	-----	-----VDLRHNL	2595
SHRIMP	LSY-----	-----TQ-----GSDTNMETDGPAGV	2606
SCORPION	-----	-----SVKNIDEQI	2633
SPONGE	-----	-----SIGTGML	2657
HUMAN	-----QE-----	-----GSL SAR-WPVAGQI	2635
ESHARK	-----	-----QE-----GSLTAQ-GTIGGLV	2646
LIMPET	-----	-----GVEDSLDGGV	2598
LINGULA	-----	-----SFDDSFVGV	2623
TRICHOPLAX	-----	-----FSLSGSSSTDEHLL	2622
STONYCORAL	Q-----	-----ES-----MSVDGSP-----GL	2671
STARFISH	-----	-----S-----QSPPDSS-LSRGEI	2681
LANCELET	A-----	-----QS-----LSQGGQD-TLGGQL	2672

Supplementary Figure 4: CLUSTAL All phyla small

APHANOMYCESE	KATQ----	DPIWSQ	CAQH-----	FTQSQV	ESS-----	APN	2380
FLATWORM	EATQ----	LHPSAA	TA-----	GLL-ADS	-----	QD	2839
STYLONCHIA	RATQ----	VPVFTQ	QSDVSS	LIA-----	SNF-----	YGNR	2717
TRICHINELLA	RTYST	ESTAWP	PGFTPT	AIT-----	DLKKNV	GNISAD	2594
HETEROSTELIUM	RATQ----	LPMFSL	QSSFSQ	FYP	SGSSSS	SYSELSS	2743
GLOMUS	RATN----	EDLAFSL	LGP-----	GN-----	ADLGSQ	-----	2704
MOSS	RATM----	TPSLSQAV	QT-----	QGGT-----	-----	LSST	2649
TERMITE	RATQ----	ASLAFQP	TEQ-----	SGSSIG	SL-----	PS	2610
SALPINGOECA	RATQ----	ASLAFTP	TMASLTG	---TAA-----	TAATF--	EPGGIS	2686
ROTIFER	RATQ----	QTLQFP	PL-----	KVYDWL	TQSSID	TF-TDTA	2627
SHRIMP	QATQ----	ANVFSAT	QA-----	PGATYN	WVTD	STFD	2648
SCORPION	RSTV----	DVREFDP	QD-----	QASKKAF	NWLT	QTSID	2670
SPONGE	RATV----	QQSLAF	TPQ-----	QESSYN	WMTP	SAQSV--	2699
HUMAN	RATQ----	QQHDFTL	QOT-----	ADGRSS	FDWLT	TGSS	2672
ESHARK	RGTO----	THYFTPT	QON-----	PDA-RNF	NWLT	TGNSL	2688
LIMPET	RATQ----	DVQFTAP	QD-----	AGSNAP	FNWLT	TGSSL	2638
LINGULA	RATQ----	EIQQFTPT	Q-----	AVKAPY	NWLT	TQSSL	2662
TRICHOPLAX	RATQ----	STNLQFTPT	QODT-----	DARNWL	DPSS	VDKSI	2669
STONYCORAL	RATQ----	NLQFTPT	QD-----	QRRSTAF	DWLN	NPTQES	2713
STARFISH	RATQ----	DAHQFIAT	QQLDAV	---ASRN	KAYN	WLTGS-Q	2724
LANCELET	RATQ----	DVLQFTAP	Q-----	AAPKNAY	NWLT	TQSSL	2714
	. T2638		*T2647				

APHANOMYCESE	S--S-----	SHRRD-----	ITAKRF	TKHRGN-----	EPGN-----	2403	
FLATWORM	LSVST	SLLFRSS	GGGGG	AGL---EV	SAAAG-GL	AGYHTA---	2885
STYLONCHIA	TDSIS	ASFYE	IINKFN	KRPNQ---	GQVNL	RIGAQSS	2772
TRICHINELLA	SDSSD	NLTV	VILDK	LQD-----	IKKPK-----	SSRVK	2625
HETEROSTELIUM	SSATT	STTF	SVGS	APDSS	QSG-----	KAGNK	2788
GLOMUS	SLTQ	SNLL	FQS	FIPSL	PRSD-----	QGGT	2733
MOSS	QGVNG	SVLY	GLSQR-	-----	PGGAGY	IKK-----	2679
TERMITE	FSLSS	LLFT	TGSS	FENQR	KS-----	YKMG	2656
SALPINGOECA	TAAQ	VLLF	FERRR	NRGANV	-----	SVDP	2723
ROTIFER	IDTK	SLLF	KTESK-	-----	-----	NKDS-----	2645
SHRIMP	QGST	SGLIF	NVNG	ASGQ	KDRRR-----	FKRPG	2692
SCORPION	SSTSS	LLFT	IGSD	TKKIP	PNID-----	ENNRN---	2710
SPONGE	PTSD	SLLF	TRPT	MRPPL	KNP-----	LRI	2742
HUMAN	P-SSD	SLLFA	HKR	SERLQ	RAP---	LKSV	2720
ESHARK	P-GSS	LLV	FSR	WSE	RHRPA---	KKP	2737
LIMPET	E-TP	SLLF	SVGT	SGS	QSTNKR-----	QSKAG	2687
LINGULA	E-TQ	SLLF	NVGT	ANENQ	TPKK-KRY	KKTG	2713
TRICHOPLAX	E-TS	STLL	FLSS	KSPRQ---	RPLQ	MKPL	2717
STONYCORAL	Q-TQ	SLLF	STSQ	SHKRRK	-----	MLKP	2762
STARFISH	S-DQ	SLLF	TLG	ASKM	GRGR	QVSK	2778
LANCELET	E-TQ	SLLF	TTD	ASKK	VAKARRL---	KPVG	2763

APHANOMYCESe	-----	-----	-----	-----	-----	QEN	2406
FLATWORM	-----	-----	-----	-----	-----	QAAQL	2929
STYLONCHIA	ADLAK	FFAQ	NQYV	YRPQ	ESQ	QGQR	2805
TRICHINELLA	-----	-----	-----	-----	-----	LDGDL	2642
HETEROSTELIUM	-----	-----	-----	-----	-----	IDPRV	2810
GLOMUS	-----	-----	-----	-----	-----	RSSEY	2752
MOSS	-----	-----	-----	-----	-----	WMDPAL	2697
TERMITE	-----	-----	-----	-----	-----	SDRLAP	2674
SALPINGOECA	-----	-----	-----	-----	-----	EAREI	2743
ROTIFER	-----	-----	-----	-----	-----	DEKEV	2664
SHRIMP	-----	-----	-----	-----	-----	DTMQS	2712
SCORPION	-----	-----	-----	-----	-----	SSNTF	2728
SPONGE	-----	-----	-----	-----	-----	KRKQV	2760
HUMAN	-----	-----	-----	-----	-----	GRD	2738
ESHARK	-----	-----	-----	-----	-----	QRADIL	2755
LIMPET	-----	-----	-----	-----	-----	KSDTV	2705
LINGULA	-----	-----	-----	-----	-----	EKEEI	2731
TRICHOPLAX	-----	-----	-----	-----	-----	PSSSL	2735
STONYCORAL	-----	-----	-----	-----	-----	EKKEI	2780
STARFISH	-----	-----	-----	-----	-----	EDKKI	2796
LANCELET	-----	-----	-----	-----	-----	QQSEI	2781

Supplementary Figure 4: CLUSTAL All phyla small

APHANOMYCESE	-RTKSYFQDQAS--RSKLEIARIKQAKSKGSKVSLYRAYRVGDFPDIQIPRMDIFRPLL	2463
FLATWORM	SSSYSAFAQAGV-ERHRRQAREAAEAAAKREHRVTLRRRYRVGDLPDVQMEQGALVTTLA	2988
STYLONCHIA	--MPAHLQKQEE-IRKMQREQLQRQIQKQHQVGLYRRYRVGELPDIQISYEDVLKPLQ	2862
TRICHINELLA	--EKAFFVNLNR-KRQKVIER-L-----KQQSLDLRGKYRRGDFPDIQIPYSAVIITLQ	2692
HETEROSTELIUM	--RNAAFARLAV-KKSKDRDELMSRAKQARENQVTMFRKYRSGELPDIQIKLQELLRPLQ	2867
GLOMUS	-----DFKQMMATQRKQDEIYRTSQHAFPKNISMLRQYRVGELPDIGINHGDLINPLQ	2805
MOSS	--QSQVL--TGVFRRASRRREARLKLQSLERANKVHMMRQYRTGELPDVQIKHADIVGPLA	2753
TERMITE	--KRIFHASREI-QRSARQOELEQERGRLEANIASFREYRSGDFPDIETISYSAIIKPMQ	2731
SALPINGOECA	--QAAIFHAKRMAARKQEARRLIELRRKARAAQVTLFRSYRTGELPDIQIKQRELLQPLQ	2801
ROTIFER	--QSKFFARKQI-AKKNRDEDLRKQLKAKRENHVEKYRNYRIGDFPDIQIKHSELIAPMQ	2721
SHRIMP	--QSIYFAKIEE-RRSKLREKLEKERKFRREAQVTMYRQYRVGELPDVQIPHRALIGPLQ	2769
SCORPION	--SRLHFIRMEM-RKQQLRQEREKEQKKQREGQVTIYRQYRIGDLPDIETINYSSIIVPLQ	2785
SPONGE	--VSSFFAMNEA-RKKMRREELKQRRARQSVVVMYRKYRMGELPDIQIKHSELIIRPLQ	2817
HUMAN	--LSLMYARKGV-AEQKREKEIKSELKMKQDAQVVLRYRSHRGDLPDIQIKHSSLITPLQ	2795
ESHARK	--VSLIFARKGI-REQRAEQKIKTEKRMERDAKVTLYRSYRFGDLPDIQIKYSLLIAPLQ	2812
LIMPET	---RLFFMKKNV-RLRKREBERLMEQKSRRENQVTMYRKYRTGDLPDIQIKHSYIIAPLQ	2761
LINGULA	--RSTYFAKNI-RLQAMRQEALKEQKLRREAQVTMYRKYRTGDLPDIQIKYSYVIAPLQ	2788
TRICHOPLAX	--NNAFYAKRER-RKKQLREEILKQKRIARENKVVMYRKYRDRGELPDIQIKHSELIAPMQ	2792
STONYCORAL	--ISAFFAKQAL-KRNKFRQALQRQKAAREGAVVMYRKYRSGDLPDIQIKYSELIAPLQ	2837
STARFISH	--SQAYFARREM-KRKQLKEKILEEQREKRFSTVTMYRKYRTGDLPDIQIKYSDLIAPLQ	2853
LANCELET	--TKAYHARRQI-RMQKMRERVKEQRAKRGNLVTLYRQYRVGDLPDIQIKYSYIIAPLQ	2838
	: ** *::** : : . :	
APHANOMYCESE	AVVASHTATATSLFSIILSTVLPNLSASTQSQVIT-----KIEALLQ-----	2505
FLATWORM	GLAQKDRMFGRLCAQLSQSMVDWAASALSSEDDVADMCRRLLAAAWLGVLIPTSPFDGKRR	3048
STYLONCHIA	AITKSDLTIATEVFVEIFSELYKSNQDQ-----QRELLGQGVNRNLLN-----	2905
TRICHINELLA	AVAEldrVfAGALFESLMCGVAANVIEIYNFEMTEKYFDSISDGLRDI FR-----	2742
HETEROSTELIUM	SLCQMDHHVGTSTVFSLLFTTIYQHCPRDQNE---KFKSSCKQSIEKIID-----	2913
GLOMUS	TLAQRDLDISRTLFTSLFVSIYNQLDNNIQVSEEIKEYKKTIGRHIQDIF S-----	2855
MOSS	ALAERDPTFARLLLRLILCSAVYSLPSG-----GQDIKAEVRLGLEAALR-----	2797
TERMITE	ELAKRDAVARHLFVLLFDGLLGEYLYDE----KEVYTKVQVKAMGSTVS-----	2776
SALPINGOECA	GLAQRDQPQLARMVFESLFYVGLHELPHDILSERDAANMKAEBYKAVNGLLQ-----	2851
ROTIFER	GLAQRDSQIAMVLFESIFVSI LSEISYLKDEQDSYKILKELTQYLNAMLA-----	2771
SHRIMP	ALSQRDEKVARLLFEVLAQGVINSAGTAMHHREQEWNQELHEALNGILS-----	2819
SCORPION	ALAQHDDEICRMLFQSLILSVCCYMKSNQV-TEYSEFCRSLSSALNEILK-----	2834
SPONGE	ALAQNDSGLARLLFCSLFN SIFSQLDHLLTEEDAATAATKGVIEGNINTILD-----	2867
HUMAN	AVAQRDPIIAKQLFSSLFSGILKEMDKFRTLSEKNNITQKLLQDFNRF LN-----	2845
ESHARK	ALAQKDHS LAKQLFSALFSGILEVHKS KTA-ETKDISKQLVENFNLYLK-----	2861
LIMPET	ALAHRDSTIAKLLFSSLFKAIYKMKDEVKTEREMEETIELINTSVETM FN-----	2811
LINGULA	ALAQRDNTLAKMLFSALFRAIFSELQVKTERTETEMMAQISRSLNAMLD-----	2838
TRICHOPLAX	ALAQVCYLDQNYRYVNL S---VNDLVENFNDEDAAEKAEIKASLSNIVK-----	2839
STONYCORAL	ALAQCDNTFAKQLFSALFRGIFSKIDEKLPEREAA SVTSDLRSAMNHMLS-----	2887
STARFISH	ALAQRDASLARLLFSSLFRGIFSEIEEVKTEREAESTKVEINRHLNMTLS-----	2903
LANCELET	ALAQRDSMLARLLFSSLFRGIFEEIENVKTEREAEDLTEQISRFLNTALS-----	2888
	: :	
APHANOMYCESE	-----QS-QHNTFFVASLHQAYLSLLRHP--S-----TLLLA--PDIVGISS	2542
FLATWORM	NGLSAVTAATNDPALIGCALDSL C---AVASSACDGGVGVVDVGAIIRPSDYGLVAAAA	3105
STYLONCHIA	-----ESILYDYGCINCIHRVAM---ELLKTD-----GFTIE---ANIIQRTG	2942
TRICHINELLA	-----SMVTFHRPLVSCLMNFLY---NFI--E-----YVHFE---PTDIANVA	2777
HETEROSTELIUM	-----SNAT-NSALILSLLKIVE---KNL-----ELTPS---PASIASAS	2946
GLOMUS	-----NSTMNFPPF IGSLRICY---EVN-----DIEID---PNMIRKAC	2889
MOSS	-----QT-HNGISFVGC AEALCL---EDP-----EIWIS---PKIMGSAS	2830
TERMITE	-----TTKDYTTMVMGAVMEIAL---CHS--R-----YITLQ---AEDITTVS	2811
SALPINGOECA	-----ATRKGYPPIAALHNL MR---ASD-----PAIVS---PMTVSLTS	2885
ROTIFER	-----SSEFNSNFIACILEICI---KNP--K-----LLKLD---PGLVTSAC	2806
SHRIMP	-----SSYMCCPQMLRTVHLMI---NN-----DVRTN---PESLTAC	2852
SCORPION	-----KSVHYHPQLVAFCYECLN---CDV--K-----EMDID---YEQICTAS	2869
SPONGE	-----CSTQYYPPIGSLQDICY---YEN-----SLKIK---PPSITTSS	2901
HUMAN	-----TTF SFFPPFVSCIQDISC---QHA--A-----LLSLD---PAAVSAGC	2880
ESHARK	-----ATTLNFPFVACIQDMSC---QHK--D-----LLGLD---STSVRSTS	2896
LIMPET	-----TTSQYYPPI LSCIMDIV---VLR--S-----RLKIS---PSNLSTCA	2846
LINGULA	-----SSTQYFSPPIGCVENIVY---NNS--G-----RLKLE---PSAVDTAS	2873
TRICHOPLAX	-----KSKHYFPPIIACVQDICY---QQK-----ELSIQ---SSFASVAS	2873
STONYCORAL	-----SSTQFFPPFISSIQDICY---HEC--K-----LRSVD---SASVSTAC	2922
STARFISH	-----TSTQYFPPIISCVQEISY---YHS--E-----QLTLV---PSTISTAS	2938
LANCELET	-----NSEKYFPPIISSLQEICY---REP--R-----KLSPD---ASVIQQTG	2923
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Supplementary Figure 4: CLUSTAL All phyla small

APHANOMYCESE	IASRNFTTQQRILEEIIIRAAD--S--R-----I---	2567
FLATWORM	SAAHLPTLALALELLYAWQGRPGVQQSRDEPGRHRGRAAKATTEQLPTAAKRRRMEAG	3165
STYLONCHIA	QHSMFQTALALLEESIIHGKQ-IQDEQ---FQQAMGK-----QGNKKRRIQDN	2987
TRICHINELLA	IGSGQPDCGIVLLEERRIEVGFV-DISAV---TCQ-----EKRL---	2811
HETEROSTELIUM	NASGNHPMGIIVLESIIIESLLP--T-KP---SSK-----QYA---	2977
GLOMUS	SLSTESLGIILIERQLLRTSV-E--R---ESK-----RLRT---	2920
MOSS	RKSTNYHSGIMLLEKQIMNETF--PEPE---PNVS-----SKRQKG---	2866
TERMITE	RFSGLLALGCLSLLEEILIQKDT-VSEAG---SSK-----RSKT---	2845
SALPINGOECA	AAGRSFHTGALLLESTLAAAE-EAAMQ---PSK-----RSKM---	2919
ROTIFER	LNSFRQSLGIILLEEYIIFEE-DSDAP---LEK-----KVRL---	2840
SHRIMP	LGSRLAALGILVLERQALLSKR-GEEPH---PAR-----KMR---	2886
SCORPION	QASHKQSLGILLLEDHLICYNN-FKSSN---PAK-----RIKL---	2903
SPONGE	LASKQEFTGIMLLEKQLLNVD--S-SK---SAK-----RSRT---	2933
HUMAN	LASLQQPVGIRLLEEALLRLP--A-EL---PAK-----RVRG---	2912
ESHARK	LASLQQPMGILLLEKSLIHSTT--NEEP---PTK-----KARG---	2929
LIMPET	IVSSLQPLGIVVLEEQLIQDTS--TEQR---GNK-----RRKT---	2879
LINGULA	LISMQQPLGIVLLEEQLIQDGS--IERR---PAK-----RART---	2906
TRICHOPLAX	LASSQQPIGILLLEKQIMHLDT--EEP---PSK-----RIKT---	2905
STONYCORAL	LTSLQQPIGIMLLEKQLLEIEG--KSN---SRK-----RAKT---	2955
STARFISH	LTSQQMHGIRLLEENLIQKPW--QEEK---SAK-----RARF---	2971
LANCELET	VISLQQPIGIVLLEEQLVQKAG--VEEP---RSK-----RART---	2956

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APHANOMYCESE	-----VSMAWNQLHHILQMVQNESYMMALSA-ETCV-LSE----	2600
FLATWORM	SQESNDDNSADVGTGHADRHEEAYWLALARLYRDMGEPDQQLGALRRCSR-HNG----	3219
STYLONCHIA	SGQN-QKNGTGFMFNKVLGDNRKYWFNLIDLYDQIGNDALQGIWTFLADE-EGIFKVK	3045
TRICHINELLA	-----KQVNETDRLWVELARLYKQCGELENLKAFTKHLT-TEK----	2850
HETEROSTELIUM	-----QNQATISESWDHLRELYHALKEEDIVLGLLERQMG-LPY----	3016
GLOMUS	-----T---SSSLVASSKRPWIELSHLYKSIDGHDVYNSIYESKIVV-SEL----	2962
MOSS	-----KGGQANRLLRPLEDAWLELAELYKALGENDIVLGLFGTHVAK-HEK----	2911
TERMITE	-----FEPSTEEILWLSLADLYKHMDWDVVRGIFHKYLNC-GEN----	2884
SALPINGOECA	-----RR-ARNGLTDEIERWIYLRFLKELGDYDTLHGIFSNQVLS-FEA----	2963
ROTIFER	-----N---PKDSSSEASILWIELAKLYRSMNDYDSIKGIFLVKSDLVCEH----	2883
SHRIMP	-----K---DAEALSQDDSLWLSIAEMYKNLNMWDVVRGVVQKGLGAIKEE----	2929
SCORPION	-----N---K-PLISDELSIWLKMAEIKYKSLSDYDSVHGIFSNLSNI-QEE----	2944
SPONGE	-----NKSNEVTETWIELARLYKSLEDYDVLHGIFTNLDDT-KDV----	2972
HUMAN	-----K---ARLPPD--VLRWVELAKLYRSIGEDVLRGIFTSEIGT-KQI----	2952
ESHARK	-----R---QELPPDTPDVARWIELATLYRSLGDYDVLRGIFSEKIGT-KPL----	2971
LIMPET	-----E---G-TTVSTDVNLWIEARLYKSVENYDVLHGIFSGKIDT-KPI----	2920
LINGULA	-----S---A-TVPSQETSWLELARLYKSLGDFDVRGIFSSKIGT-KKI----	2947
TRICHOPLAX	-----SSASEATSNIWIELSKLYKSIGYDVLRGIFSGHLGT-KDI----	2944
STONYCORAL	-----S---T-VPPSEVTTWIELSKLYRSGDYDVLRGIFTGHIGT-KDI----	2996
STARFISH	-----V---S-REPSPEISTWIELARLYKALGDFDAVQGVFSACIGT-HEI----	3012
LANCELET	-----S---S-SPVSAETAWIELARLYKSLGDFDVLQGFIFSRKVG-TQTV----	2997

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APHANOMYCESE	-----TNLALHAQLSGDLVAATIQHYKDAEGKFKLLDKSQ-----DVSL	2638
FLATWORM	--QEGVDN---NDDEERFNALDWCLSGDVLALATFDRLFRQ-ADESGTESASAADSAT	3273
STYLONCHIA	DDQEKLSQDQERTVNLIKEAHCLRTKGSIDKGLKVLEQALND-KSLTDC-----LED	3096
TRICHINELLA	-----TKLALMEAAAGDFEGAATYGETFSNKQS-KSGD-----IVEK	2887
HETEROSTELIUM	-----TKRALEAELSNDVAVLKAYDDGMAALESGQLAI-----TPSA	3054
GLOMUS	-----TKDALNAELLGDYALACKHYLEALKSEAD-----VDD	2994
MOSS	-----TRALEIQLGGDLRQALDLYDQVIAIYEDGSLSG-----DITK	2949
TERMITE	-----VHKALKWETSGHWDKARMEYEALSS-MDDQDG-----	2916
SALPINGOECA	-----TQRAARLEAAGRFDAAEVYKECMFKEEDEEDDD-----VPA	3000
ROTIFER	-----TERGIDFEAVNDYYSARNEYGAALDS--ELLEN-----VSQ	2917
SHRIMP	-----TQKALEAEATNNHVKAFLLYRQSLDT-TDWEE-----PLA	2964
SCORPION	-----TKQALEFESRGEYLLAVKIYSKLYDQ-TEWSAEE-----PNQ	2980
SPONGE	-----TRKALEAEERGDYLTALNLYKKAIDF--DWPQGE-----SPPQ	3008
HUMAN	-----TQSALLAEARSDYSEAAKQYDEALNK-QDWVDGE-----PTE	2988
ESHARK	-----THTALLAEAKSDYAEAVRLYDQALNT--EEMDGN-----PME	3007
LIMPET	-----TQEAAMAESKGDYQNTANKLYDEALS-I-QDWAGED-----PLE	2956
LINGULA	-----TQDALEAESRRDYKTASHLYREARQC-DSWTGDE-----PDG	2983
TRICHOPLAX	-----TQRALEAESRHDYAAAVKYNNQAMDC-SSWPDGE-----PQA	2980
STONYCORAL	-----TREAMEAEARGDYSQALKLYNEAIGTDDVWIKEE-----LRQ	3033
STARFISH	-----TKTALAEARGDYSTALKLYNQAF-E-MDWDEGA-----VSQ	3047
LANCELET	-----TYEALAEARGDFKKAVELYNQAMQE-TEWDPDQ-----PLA	3033

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Supplementary Figure 4: CLUSTAL All phyla small

APHANOMYCESE	LEQQRWKSEQYNCLATLNRWDKVL EEVES-----LDLWQQNEPFL	2678
FLATWORM	AVNNACQLARLDC LTR LADWSRLSGVSKLLLP-----ADGEEGSGLADR LWSRV--GV	3326
STYLONCHIA	HILCELENKQLDSKAE L LKWLWDELAKDMSEKY-HS-----KQLSEI----	3135
TRICHINELLA	AESNLLEYEARIRC LEM LNDWKGLETWSTTF S-AS-----GKTAKLNQIWETD--YL	2935
HETEROSTELIUM	RETS LWENGR LQCYESLREWSNLKANFIAYY-PG-----GPQSVFEEQDEAT	3100
GLOMUS	IEVALWEERRFDCFEKLCQWDDL AETVLVDI-----EDNLSNLWED---EL	3037
MOSS	SEIDIWYNQRLACLADLNEWEVLMEIEYES-----MEGDNSEPDFKRLWEP---TK	2998
TERMITE	-LSDYYEALYKCLAHLS DWKGLNNQVRRQV-----ENNL DQLWTD E--WL	2959
SALPINGOECA	CEVDLWEETLAECSLR LDCWGELENNTLTCINPDVEYEGEGTDLAEVIDANN I WVQP--RL	3058
ROTIFER	SEQDLWLESLLKCCNELTDWKAMCEWSMNG-----NTLDQLFEDA--YS	2959
SHRIMP	AENRLWEEWYSNCAAILGQWSELNFVEKRF LQDD-----DGEVDLNRVWLLP--KP	3014
SCORPION	AEIDLWDNAILQC YDYLTQWDLQLSIIINRL-DEN-----QKQPNLNKI WEEP--YY	3029
SPONGE	VEEDLWEDSLLNAYSHLTKWDL EKASTCNI-GE-----ETNSKLEQLWKDS--YC	3056
HUMAN	AEKDFWELASLDCYNHLAEWKSLEYCSTASI-DS-----ENPPDLNKI WSEP--FY	3036
ESHARK	TEKDFWEIAALECYNHLETKAL EYCS TVNI-DD-----KTPAD IENI WSDT--FY	3055
LIMPET	AEIDFWDDSRMQCDH L TQWKDL ETVCLTAI-DN-----TELPNLDK V WEDT--LY	3004
LINGULA	LEQELWVDAYLLCVDQLMSWEELGTEAMDCI-EG-----LEETGLNKI WEDA--YY	3031
TRICHOPLAX	EEEDLWEISRLECLYNLTQWKLE YLSLVNVI-DN-----NDPPSPDKI WEDN--YY	3028
STONYCORAL	EEEDLWDVSR LQC LADLTKWKELEKCSVESI-DD-----KNPPDLDK V WSDT--FY	3081
STARFISH	VEEDLWDESRLNCCNQ L TQWKELQNYSTVNI-DD-----NSPHDLGKI WSDT--FY	3095
LANCELET	VEEDLWDDSR LQC YDHL TQWKNLYEVSTVNI-DE-----DSPPNLDKM WDDT--YF	3081
	. * * :	:
APHANOMYCESE	A---NHMGYFLEASMALN-----D---NDR LKSF FGSINNOQSDKQRYLNSRFPDI	2722
FLATWORM	QNVCKNALSSYML SSTR LVC DKPESAIGSDSES AEFMDFLRCTTDND SVRTQFESEHAEL	3386
STYLONCHIA	-----PFKH---AEKMIRAQIR---TDEYWNNTKQIAFWQKDQVSKAYLDKNFNVE	3181
TRICHINELLA	IN---MHLPVFLRSK LKIALTSDSA---A---LEELSAFVEQNTVPKNREIL ENRHSGL	2986
HETEROSTELIUM	RH---EMMSHF LQYSLKVK-----ENWPDLYQFMGSL--TPSQHYM ESSFPGE	3144
GLOMUS	QD---IYLQHFVHSFFKLSLSDDD-----NSEYRQRFDFIDGAMNNQYQKSLLTQYPIE	3089
MOSS	QE---IYLG YFIRGAVKEAKY-----HGLLTEFVQSSSEILPKRQFL LNEFSTQ	3044
TERMITE	QE---KLLPQILLSEIQMMLDKG-----VDSKREQFLQQVDRWLRDRDKSDYLS SHYCEE	3011
SALPINGOECA	LQ---RHLPHLITVRLELGISAV-----V---CACLQAFVEAARPHDRWAHLQYHFAME	3107
ROTIFER	IE---NVFPYAFRSK LKLLIQEDEN---EQKHKDLIRFINGL---EVEKKKYLEQSFQCE	3011
SHRIMP	TA---TALPALVHSK LLMNILDGSE---T---DGNLIAFIDQSGMDHRHRSML EGDLP LQ	3064
SCORPION	QE---NYLPFLIKSK LKLLIENR-----N---DQSL LCFIDSALKEENKKKYLEENFSEE	3078
SPONGE	QE---HYLPFVLSK LKLLWCTDD-----S---DHGLASF LDKSLSEANRSVLESHYPQE	3105
HUMAN	QE---TYLPYMI RSK LKLLLQGE-----A---DQSL LTFIDKAMHGELQKAIL ELHYSQE	3085
ESHARK	QE---TYLSYMI RSK V KLLQSGE-----V---DQSL LTFVDRAMKVEQRKAVI ETYYSQE	3104
LIMPET	QE---HYLPYIIRSK LKLLLLGG-----D---QQSL LTFVDTSMKTTEYRAVLESRYSE	3053
LINGULA	QE---HYLPYILRSK V KLLLQGNE---D---QQDMLDFVDNSMNV EEQKIFLEARYSEE	3081
TRICHOPLAX	QE---NYLPPLFLSKAKVMCENDLA---G---SDDFIQYLNKSLANDEHLSVLENRHDCD	3079
STONYCORAL	QE---HYLPHLITSK LKLLCQGS-----G---DMTLNEFVAKAMKTSERAALRSRYSDS	3130
STARFISH	QE---LYLPHMMRSM LKQLMEGG-----E---DETLLQFIDASMSDADKRAFLEARYSEE	3144
LANCELET	QE---HYLPFTIRSK LKLLLEGE-----M---DQSL LNFVDSAMQKPRKALLESRYCEE	3130
	: . :	:
APHANOMYCESE	LAAIYLQCQQTSDAQAAVEDFYQTC L NQWSSMPTAHQKR----QLERLPNAVFLDEVLN	2777
FLATWORM	LASVLIKTGKYHNAMAYVDSALDRVLNNVSSVPALQRQF--HLSNMA SVHRLTELRESLT	3444
STYLONCHIA	LAINSLTCKDYDRARFYLDKETNELLSQWKNLTKLSQVA--QHFLVQRIQKIYEMREFLQ	3239
TRICHINELLA	LVLNLILREDFTKSQYFLNVAIDSF LKCYPTLRVCDVTA--RLKL VQDLLPVSETAKFLH	3044
HETEROSTELIUM	LAFLEITRSDFNRSQYIYIQFYRLFRDQWASTHPLALAS--RHRILQPIQKVVEVEEFLG	3202
GLOMUS	LALSSVTKDL EQGRFYVRKAFDNFLFAWSTLHPLAIGT--RLGKLSLQQIIVEIEEFLN	3147
MOSS	LATLAAINK EWDRA RFYLGC HLI FRRQWSALHPFALGS--RHQRVRLQKIVELEEFIT	3102
TERMITE	LAAIFLIQDKLDQAQHQVEHSLTMFLDSWAALNPSSHNL--RTKQLLDLQKTAE LKACLA	3069
SALPINGOECA	LAMLSVLR EDDFLARYHLSQALQRFLDDVNTLSPLMTET--RRASLQR LQCMVELQEFLD	3165
ROTIFER	MALISLHQNDLSAANYAH LAIQKYLTEWSS TNKTIKQN--QINKLQSLQ SIVELNEFLK	3069
SHRIMP	LGVLA AHQEKFEQANVYANTATSM TLLT LLSQYSVLT PNP--LLDTLQNVQLLTELSDCLN	3122
SCORPION	LALLYIIQENYDRAQYYSQ LCLQDFLKEWSSLNVLMP I I--RKT LQSLQKHIELOQFLH	3136
SPONGE	LTL SYVLRDDYDRAYYLSLSLKAQQIWSVQDGISSSTGAVSSTVQSLQR LRTMNEFIT	3165
HUMAN	LSLLYLLQDDVDR AKYIYIQNGIQSFMQNYSSIDVLLHQ S--RLTKLQSVQALTEIQEFIS	3143
ESHARK	LSLLYILQDDVDR AKYIYINNCMEVFMQNYSSIDTLLHQ S--RLTKLQSLQAVTEMQDFLH	3162
LIMPET	LSL MYLWQDN YDRARHYANLAKQFLQDWSSTDTLIVAS--RTSQ LQTLQPLVELHEFLH	3111
LINGULA	LALLYLFQEDYARARHYTSIVFKTFLQDWSIDTLM TTT--RIGKQLQLK LKTEMQEFLD	3139
TRICHOPLAX	LALIHV LLEKYDRARYYLD FSIQKFLQDWSALDSTLLYS--RASKLQSLQTLTEMQEF LQ	3137
STONYCORAL	LALMYVLQDN CDSASYAALSEQSFLSDWAGLDSNLRSS--RSIKLQSLQKITEMQEF LK	3188
STARFISH	LSTLYTIQEDYDRAMFYLANCRQSF LHDWSGLGPLMISS--RRAKLQCIQR LTEKQNF LK	3202
LANCELET	LAML YLQDDYGR AKYIYVGNCTDAFLQEWSGMDRLMTSS--RAAKLQSLQK LTEMQEF LK	3188
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Supplementary Figure 4: CLUSTAL All phyla small

APHANOMYCESe	-KLQAAS-----GLHGNDRARVISQ---VTNYAALTRLFE-----	2932
FLATWORM	DRNFDAM-----SVA-----EKVAKVRRQLISPSPTWE-----	3612
STYLONCHIA	DKLQKIVKVFDSKMQESFGED-----QQFQEDLRTEIKCILLK-----	3424
TRICHINELLA	AYLMQALNLFDL---KRISDP-----EV-NVTEGSSADQFALIGMLFD---NVAETVV	3216
HETEROSTELIUM	DRFIKAL-----KFVESKSDE-----DSIKNPNLQRYKRLHGNIQW---EIQYLDQ	3387
GLOMUS	EILLALS-----EEFKVKVSS-----DSRDDIKMRIIESEYTG---LLVSELD	3311
MOSS	KKLQQLL-----VYIETERRKLSKHPEFLPEFQM-----EQADV	3277
TERMITE	KLGLDSWSVIEDQ-----RFEQYPMLHAETLQHVSVMAAGILQ	3233
SALPINGOECA	H-YFRAF-ARDLDRLNKCSADLPPSKSG---AHSLYKAEVLLSLGKIV---PLCPATD	3374
ROTIFER	ESFFESMVLREILKYDISDFTFKNNQKNY-----LYQEQRVLSKFSK---FLIESLM	3284
SHRIMP	KYLVEAWA---KYLGRVSSM-----SILDQNPVREIQYLKLESHLCL---EICRAIQ	3296
SCORPION	DTLLCAH---KQLAKLDLHFP-----KKLDVSTMNHYLLQSEIIE---MAADIVK	3335
SPONGE	EAVISLT-----CQMDNFKRGLGGSGKGAIS-SKPFISQHVLLGKLLN---KMAEIFA	3365
HUMAN	LTVLKTV---SLLDENNVS-----SYLSKNILAFRDQNILGTTYR---IIANALS	3342
ESHARK	VTVLKSI---PLLVEINV-----DYLNTHTRILRDQNTLLGSSYC---ILADALN	3360
LIMPET	NGLLTTI-----GKFNDS-----DVLKSKPDLYRRHHVLTATSYE---LAECSL	3291
LINGULA	SPLV GAL---GLLERKRDH---KLVKSNVLTTRRHVLVQGNIFD---SVTSSLL	3320
TRICHOPLAX	KTLLTAN---SQFEKVKDL---SVILENTLMREHLLRSRLLD---MTSKILA	3339
STONYCORAL	ETALLVA---GQLDKFSAS---KILEIEPLRGIQHILRSKTFD---ILCKAML	3374
STARFISH	MTLLTTF---DPLAKLSNT---PALTG DYCLTRHHHTLTSKSYD---LVAIAIQ	3388
LANCELET	NNVLTTF---EQLDKFSSC---RVFEEDLAVAKQHHTLTSLSYE---IVAHALI	3375
APHANOMYCESe	N-D-----EVLELISTMPPDAQAE--ICGWQARGLMES	2962
FLATWORM	AAGLCDRASAA-----LLRIQLASSPPSTGQANM---RAEAEA--	3647
STYLONCHIA	KKMLNI-----IFQVSAEKEIKH--LQRYQKDC TT--	3453
TRICHINELLA	ASSENT---L-----AEFCL---SR--WISKTDADISEL-----VTM--	3246
HETEROSTELIUM	KLGSNL-----VMENLKK-----NGLTSLSSLP TT--	3417
GLOMUS	K-RVFN-----RNLKIKHKKNY-----	3328
MOSS	NARVAWAT-----LSSQSGEGATSQDITACFA-----	3304
TERMITE	QLEQQPGVLT---K---LPAAE-----VKKLADRIGAPDCSQDTL-MQN-----	3270
SALPINGOECA	ENKVLWDHI IAEVDAPDATRAGEKCI VRAFDV LLETAQRAP TDPKAL-PVGWRKVPSK--	3431
ROTIFER	DHMNQTFDFD SGL-Q---GIITEKKHV---LQLSDYVKNDINDFEKT-ISS-----	3327
SHRIMP	DMGGDW---T-----EDNQY-----MQVLSKKFENANGKESW-QRE-----	3328
SCORPION	YNDVHA---E-----KIQELTDFPSIQSKSL-EID-----	3362
SPONGE	TPEDGM---LAL-S---ALSNDGN---TKLNSLIGGTPSTSTKAI-SEG-----	3403
HUMAN	SEPA CL---A---E---IEEDK-----ARRILELSGSSSEDSEKV-TAG-----	3376
ESHARK	KEPTCL---Q---R---IKEDQ-----AERVIEHSGSSSEEQEV-VIG-----	3394
LIMPET	AAELPQ---S---L---SSKTC DK---LKNL-LKTDNLDKTQVNI-VSD-----	3326
LINGULA	SLPDFS---S---V---SPRDIQK---LVEAASC SQNA-DMQEI-ING-----	3355
TRICHOPLAX	ESDASI---L---D---LLN-EKK---ESLYQLANVNQHDSKEKI-AAK-----	3374
STONYCORAL	DGGVVI---A---T---L-ESQAK---NALVKLCRIDETESQKVV-VSD-----	3409
STARFISH	KGGADI---L---T---GLRNVGK---LDKLLGLVGONATRPEQI-CST-----	3424
LANCELET	QEGGAI---L---T---GLKDTRH---AQLLTAAGVSPDTSVDQT-ISS-----	3411
APHANOMYCESe	SDFQREYGPST---SVK-----LS---SAAL-EIFQYQTSKATNVTTMHLTYIEYLDKI	3010
FLATWORM	-FDKSALS NLQS---A-----ASKADGV-----GFADVGSSSLQCHLELIRFC DSC	3689
STYLONCHIA	-YLDRSFKTL DQ---VIKKVQT-AAQ-----FDDQMKTMAKTYFKFAQFSDKI	3497
TRICHINELLA	-CYGQAFRYLKL---SCQ-----YSS-----QLNIESPKLTEPLMELSSFC DRI	3286
HETEROSTELIUM	-LFSLAYQSYSQ---SIQ-----LYDSNS-----NNNNDTHKS KSAYLQFGNFC DTE	3460
GLOMUS	-FIERGYNLFNN---ATK-----EI-----SLQLKPSMHAKILVKFAKFC D YF	3367
MOSS	-LLGSAFKTYST---ALD-----NDDPLS-EIT TGSLSPHDTAKALLKFGLC D EL	3350
TERMITE	-LKKYGLSSLKTA AEVVT-----PRGNSEQAVAKAYLQVAKYCR AH	3310
SALPINGOECA	-RRAGQFAYVSPFGDRVGNVPSHAPKFNKNPLDVLFP SATAYGSETLNAFVRLAEFC ADV	3490
ROTIFER	-LMKHGVDNL-----LKIKDSLKGSLELATYCD FY	3356
SHRIMP	-LLSCSYKSLQL---AVN-----CAEGKLVKSDAL-NQDSSKKS DSDAHLALVKYCEEC	3377
SCORPION	-LFCKNY EYKCR---AID-----IIQEVEQ--K---MIEFDQATIGET YFKFAN YCNKI	3407
SPONGE	-LWIQALSSFNA---GVR-----SGTTLN-----PLTKDPVPTVQSLEELFGCDNA	3446
HUMAN	-LYQRAFQHLSE---AVQ-----AAEEEAQPPS---WSCGPAAGVIDAYMTLADFC DQ	3423
ESHARK	-LHRKTLHYLER---AVR-----KAEEEVQSLA---GEHVDIAGVIEAYVNLANFC DRC	3441
LIMPET	-LLQKSHQELKS---AIS-----DSVVT RS-----RSEST EADAQIALSKFC D KF	3368
LINGULA	-LVDRGYQYIKE---AVD-----IYEEDS-----SNDKSTVETHMALAKYCDKY	3395
TRICHOPLAX	-LTSHACQALHQ---AVK-----ASKEERG---GSSYIEAMMMVNFCD DI	3413
STONYCORAL	-LMTRS FVSLQS---AIK-----AAKNAEG--K---CNTTQTS GTV DAMIAMVNFCD NC	3454
STARFISH	-LYSKAYS ELKQ---AVS-----LADKDD--A---VTSQSERSMTEAYMALVSFC D RM	3468
LANCELET	-LLQKGHACLQK---AVK-----LASDEEKARQ---D TSLDKSGIVDAFAMMVGFC D KI	3458

Supplementary Figure 4: CLUSTAL All phyla small

APHANOMYCESE	IERTP-----SSTDLVNQFVTNVLWGM	SMDAK-GCSAYFPRVLGLLRE	3052	
FLATWORM	LLEAAPNQPPQ-----FRAALRAQAVDSVTS	AMRCGSQ-EASIRFPRLLCLLGE	3738	
STYLONCHIA	LRKMENDQCRYVITNSLKLQNLKSEEQVARD	SIKYGLLSLNHEYQ-NASDIIPRLLDITSK	3556	
TRICHINELLA	LRKNGHTS-----LVNSECACVMVRSILKS	MKNESH-LARQLFPRLLSVMMEK	3332	
HETEROSTELIUM	LQRRGDQS-----E-----DSNRLAVSVVNS	SIMNAIKQEIP-GAIEKFPRLLLEIIEQ	3506	
GLOMUS	LRKLDFTTEQTQTI-----FDPAQYASNVVES	ILQAMENGSK-EATELFPRLLQIIEK	3419	
MOSS	LKLSQQPEERSQMTQHHLFGLPQASDLSLLV	RHMLKALALDSTLQAQHAVARLLSLVGF	3410	
TERMITE	SNTS-----REDNFGTDIVTSILRAMRYGSK	-DARQLFPCLLQLPGL	3351	
SALPINGOECA	LQDRAMP--KD-----SMGRVKQVFVETALA	AMRSGNV-LMRQYFPQLNLNGER	3537	
ROTIFER	LRIAENDN--NDFEKLTLIGQMIRSQFPFIVTE	QLFYSIRSGSL-EARTRFPRLLQIIEI	3413	
SHRIMP	VIKWKDHV-----DVSQYSKSLMVSVLRAM	ANGSR-DAHFFPRLINLMNE	3422	
SCORPION	LRMQEEEE--KTLSL-----SFETYPSVLTN	SLLNALKNGNL-NAIKLFPRLLQIIEV	3457	
SPONGE	LRQEDHDD--EQSTG-----LDTKSFPSII	INHTLTAMSLGSS-KARELFPRLLQLVEA	3497	
HUMAN	LRKEEENA--SVIDS-----AELQAYPALVVEK	MKLKALKLSN-EARLKFPRLLQIIEI	3474	
ESHARK	LREKEESA--TAINF-----SEQTFPACVVEK	ILKAMKYNSK-EARLKFPRLLQIVKL	3492	
LIMPET	LRMKENEE--EHIKE---K--VIENYGETII	ICLLKAMKLGSM-EAIERFPRLLQFVEL	3419	
LINGULA	LKLREEDD--SLTGE-----SIDSYPEAVVT	SLLRCELDDHM-DARQRFPRLLQLVEY	3445	
TRICHOPLAX	LRHEEDGR--ANQPK---GLIDTKIFPEVIRY	TLEAMAYNSM-DARQRFPRLLQIVER	3466	
STONYCORAL	LRKKEVSV--APV-E---V--DTKLPFGIVVRY	MKSMCYSSK-EARQKFPRLLQIVHK	3504	
STARFISH	LRLKESDE--VPM-T---YLPQTDNFSQTVV	HYTLKAMHYSSQ-EARQRFPRLLQLVEA	3520	
LANCELET	LRHQEDDE--EGT-E---LSSIPGLAAAVVSN	LQALRHDSPEARQRFPRLLQLVEI	3509	
	:	. : :		
APHANOMYCESE	HPT-L-----INMAREKLK---QIPLWTC	LHWSAQVMALMSEKPSPFNDFILTL	3098	
FLATWORM	SADDEASQNPADESLSSRFSRQMA---SVPV	WLSLPWLPQLVSLLDKPD-QGGS	AVLPL	3794
STYLONCHIA	YKDHV-----QGDFIAYSK---ETPTWY	FLRWINQIVAVVNRPE---SSVIEEKV	3600	
TRICHINELLA	YPE-S-----ELEFQAEID---SVPSW	MFLSWMNQMSALKRNS----KFYSIL	3373	
HETEROSTELIUM	YEK-A-----AKEFVERTK---QIPCW	MFIWQSQMFPYLDTPQ---GPYILPL	3549	
GLOMUS	YHN-T-----QSIKFKVES---IESVW	KFIRWIPQIVALLDQSI---AHCVP	PI	3463
MOSS	SSA-T-----QNEFERFLD---NVSSW	VFWVWIPQMLANIEEDS---GRVL	LIKVL	3453
TERMITE	DTS-L-----SELPHKES---AVPVW	MFLGWVQLLACLGTVP---GPVLHD	II	3394
SALPINGOECA	PTD-S-----DHLQVRLASATTSVPCW	MFLNWIPOMLAILDAPV---APV	VQ	3583
ROTIFER	YPDEC-----LEKFVSSSE---DIPSW	MFLSWLSQMTALLDKPQ---AKAI	IQ	3457
SHRIMP	DAS-L-----LSSFKEEYE---KVP	IWMFLWLSHILIVYDKVP---G	PALQ	3465
SCORPION	YPD-T-----IPEFIAKSK---VVPCW	MFLSWINQLLTLDDKPE---ATAV	QY	3500
SPONGE	HPD-T-----MDLMINKSS---TIPCW	MFIGWINQMIALLVDKPE---SRAV	HD	3540
HUMAN	YPEET-----LSLMTKEIS---SVPCW	QFISWISHMVALLDKQ---AVAV	QHSV	3518
ESHARK	YSAET-----LDLMKKEVS---SVPCW	QFIGWINQMAELDKKE---AVV	VQH	3536
LIMPET	YPD-T-----MPTFIKMVSENRLFP	LMFLWLNQMMALIDKTE---SPAV	Q	3465
LINGULA	YPD-T-----MQGFINKVS---VIPCW	MFTWIGQLVALLDKPE---APAV	VHN	3488
TRICHOPLAX	NPN-T-----IDGFMKSS---AIPSW	MFIGWISQMMALIDKPE---ARAV	Q	3509
STONYCORAL	YPD-T-----LEAFVKKAA---DVPCW	MFIGWINQMMALIDKPE---GKAV	HG	3547
STARFISH	CPD-T-----MQLMIKEVS---DVPCW	MFIGWISQMMALIDKPE---GPAV	HG	3563
LANCELET	YPD-T-----MDLFIEKVS---HVPSW	LCSWLGQMMVALLDKPE---AVAV	HG	3552
	*	: * : :	:	
APHANOMYCESE	EMMAEYPRALYYDFRLSQESIIDIET-----	NPRFHRLSAAALR---DVHLDQFVAAL	3148	
FLATWORM	ESVCDIYPAALVYFRLARANYRFETGD---	SGARQAAERLWQRLRR--LPLVEEFIAQ	3849	
STYLONCHIA	IQIAKKYQALYYPFKVVENSVKNVVDL--	SDVQRTQLFQKLSKYE-KTFRNLNAWAEAL	3658	
TRICHINELLA	ERIADDYQALYPLLMLKSA-----TG	DVGETDFYRLQLKLRK--TKIVKEFIDAL	3423	
HETEROSTELIUM	QEIASNYQAIYFPFKISSEQFGPTA-----	KKLTAKLEQTLK---NPLIDTLISEF	3598	
GLOMUS	FKLAEKFPGLYPLTISSEYKFDENNPLTREN	KAKIQELKQMIK---CDVDTFVTLE	3520	
MOSS	ESIAKSYQALYFPFRVSETDFGAIG-----	RQRTQHLKILLR---NPLLEGLVRL	3502	
TERMITE	LRLAETYPQSLIYAFQLSREKYNLES	SGH-V--SLKALVDQLASLLFT--DPVID	IFLRAF	3449
SALPINGOECA	KTIASSYPQALCFVPMLSSEKLFSGAA--	SS-TQRTFFTNLVRMVT---TDHLRRFVTEL	3638	
ROTIFER	ENISIEYPQALVYFRMSTENFKFSNEL---	NEQSDVQKISRHLN-TQLPLVEQFITAL	3513	
SHRIMP	ERLAAEYPQAVIYFPFGISKQYFNSS-H-	EGKLAKAMCDKVEALLSS--HKLLHQFVSAM	3521	
SCORPION	KEIGTNFPNALVYFKLSYEMYKFPDTL--	QGENKEFVMKLSLSLQ--LKLVD	EFVNAL	3557
SPONGE	IRIADTYPQSLYAFRMSSSGYKFGHNN---	SEGKELFEKLEKELQ---SQLMDEFIAAL	3594	
HUMAN	EEITDNYQAIYVYFIISSSESYSFKDTS--	TGHKNKEFVARIKSKLDQ---GGVIQDFINAL	3575	
ESHARK	EEIADSYQAIYVYPLMISSESYSYFQTA--	RGNTNKEFVERLKNKLDK--GGMVEVFINSL	3593	
LIMPET	LQIETYPQAIAYPFRISCEGFEDSA--	QGKKNKEAVKKLASLITEDKVPVLNKFI	3524	
LINGULA	IRIAREYPQALVYFPKVSKECYTFERS--	EGKENQAVVERLDFSLK--K-IPLVETFINAL	3545	
TRICHOPLAX	FRIADEYPQAIYAFKVSNEQYTFEETS--	VGRQNKTAVSKLSSKLQ---LPLIESFVRAL	3565	
STONYCORAL	SEIAKRYQALWYFPKISSEHFVFENSE--	DGKANEEAVKRLRSLE---HPLDDFIAL	3603	
STARFISH	TDIAYEYPQALCFPKISSESFTFDES--	TGRKNASAARKIGALE-S-IPLDDFICAL	3620	
LANCELET	TRIAQEYPQALVYPLKISSENFEDSV--	TGRNQEAVTSLKKTLK--VIYSLVDK	3610	
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Supplementary Figure 4: CLUSTAL All phyla small

APHANOMYCESE	HGLHHPHPEIRLKEALRYLSDVVES-----KPAKEA-SKIIAATISHVLDDESSKILGN-	3198
FLATWORM	GEVCLPACTALDWLSSAKRSIG-----QTERLRELHAEAIDQLFFDPPG----	3893
STYLONCHIA	DCLVYPEHRFKYWLQIINDIVSDDNM----RGIQKAKLKDIIIMMAYDLTCTQKDLL---	3711
TRICHINELLA	NLLSHPDIHAIDELESIIILNISN-----NSNEARKEAIAKVVSFVTFADIR----	3469
HETEROSTELIUM	ERLTHPEHRFKDYMETVKTMKK-----STPINTSEIQKLGVEIYNDCFNP-----	3643
GLOMUS	HRLTDSEIHFCNWINPVYNLVKRNYS---GVDKTAIEIKASFQKMSFLLK-----	3567
MOSS	EDLTFPQQRKLDGLLQILNFLF-----TNDSERAQLVFNEIYQDCLDTQSLKDPVR	3553
TERMITE	SCLGQPRKMLYHFVEKLEQLLN-----AKRPNCDLHMHMYDTMMKELFPSSYGKIHA	3502
SALPINGOECA	KCLTNPVMAYMDWLEEQDQAI-----KKRDQDALLTAFKHLKSELLVTSSTTASDR	3689
ROTIFER	EHLNTPKLFNFNDLIMDINNLLK-----KNDVIMKLFKDLNLLLIDLEGKIDF--	3560
SHRIMP	SLMVVPSIACKDAIQNVLQEK-----DKQKMEEGLSSEIVSEFLKQVNRSSKGN	3569
SCORPION	DSLVSPELLYKEYFKEILQMK-----KDKGDKNEIVKLYKKLCHLNFYNPRDKMK-	3608
SPONGE	EQLNSPELAWKDWYDNEKPLVGSVT---VPKRDKNAIKRVWEQMSQLLETRSGLDGKS	3651
HUMAN	DQLSNPELLFKDWSNDVRAELA-----KTPVNKKKNIKEMYERMYAALGD-----	3619
ESHARK	EQLSNPDMFLKDWVDNFRSKLE-----KK-ENKTQLKNLYSEMYSNLAN-----	3636
LIMPET	DQFGQPEMLFKDWTDDIKKMLQ-----SKNRNKSIMKEYKEIYNMLIEYKETQDTSS	3577
LINGULA	EQFGQPNALFKDWIGEMAKLLH-----VKQRNTDAVQRQCYTQMYSSLMMTQRQAGGV-	3597
TRICHOPLAX	EQLSQPDLVFKDWDEVKGLK-----KKSGSIAESIRICYQKLRDGLLVDAASNESEA-	3617
STONYCORAL	EMLTNPMEVFRDWCCEGPMKQLLEDQ---IKRNDSSQAVKQCFGAMFQLMDCRKRKTSK-	3658
STARFISH	EQLNPNPEVFKDWADDVMK-PLLNVA----KRDKNKIRQACHEIYMNLINHRSTVTDTG	3674
LANCELET	EQLSHPDQLFKDWGDDADLKRLLKVDPPKRTKEDKVTIKRLYDEMYDSSLDFRSASQDSS	3670
APHANOMYCESE	-----QIGVYNRQWITKNRKQIESMLGKHGELANKSTLQTAKGWLSQ	3240
FLATWORM	-----PQAGSHGRLRREFAARHREFLAALPTADRLVGI RSEAELQRAVGK	3939
STYLONCHIA	-----GD-QVGSYNRKFALWDKVFKEFGSNLNRVDKMSNSEI IKSQVN	3755
TRICHINELLA	-----RD-FLGSFWKCYFKYLPKMQEII FSVDLCAFDNKAENYLRLLCSS	3513
HETEROSTELIUM	-----HTV-RGDYNLKFKEWDDHYSQHFSDGSKLAKMDVKKLVELVAD	3687
GLOMUS	-----PNPY-HGIFAKEFVNRHSEYLFDCGRDGSILARMSPNDFKSKIYD	3612
MOSS	-----QTGEYNLKFARDWASLIVKELGLNGSKLRSMDAKQFSSVISG	3595
TERMITE	L-----FKDIQEYRKRLEKAES----NI-KCGNKKV---LKDICFKEK	3538
SALPINGOECA	-----EVGSAWKAANKASRNFMDDQFGTDGSKLLRMDAKAYAKVKKV	3731
ROTIFER	-----CGRLWTFDFSNFIKPLFMKQFGEQFRLLPQLSELEIKNKLQN	3601
SHRIMP	A-----EEKGEAYTRQDRAKQMAEAFTKAFGENLKKAKSLSIRD IQRELGS	3616
SCORPION	-----ERKHLKVAKVCGSVVFSEFGKDNKLI SEMPLKEASVKYET	3649
SPONGE	L-----YGGSPSLQ-KGARQKTFAQAYAKNIEDKFGKGGAKIISMSGTQLASAFNE	3701
HUMAN	-----PKAPG-LGAFRRRFIQTTFGKEFDKHFPGKGGSKLLRMKLSDFNDITNM	3665
ESHARK	-----AGAPG-IGAFRRRFVYGFKKKIDQHFPGKDGLLLLLNMNLKAFNVAVGQ	3682
LIMPET	-----TQLSYMTQTTVNG-MGEYRKKFADTFKKDFDIAFGKNGEKLASMSIK--	3623
LINGULA	-----SQDIFDTEPDSVE-IGQYRQKFAKAYCKDLDSAFGKDGKIMTMSEEAADGIFK	3651
TRICHOPLAX	-----ASSLTSGELIE-FGSHKRRFIQHFGKVEIQYFGKDGSKLQSMKASDFEKIASR	3669
STONYCORAL	-----SQRTRGTE-SGPFRTKFAQEFANEVQRI FPGKEGKLVGKMTDFSKWCRD	3706
STARFISH	A----GSSQDSQSSPSVG-FGNFRRRFAQEWQKKFEAAFPGKDGTKVIDMQLKTFSEHY--	3727
LANCELET	MSSLFSGSQSSDLESQSVG-FGPFRRRFAQQFAKECEKMFPGKDGSRILDMKEFEFMKLGK	3729
APHANOMYCESe	SFQVMPGK-----YGIDRQWKAKLSDFS DWLMQLDPVKT-----RIELPG	3280
FLATWORM	LWKRVRD-----ERDSSVATARLADFS TWLAEFAATEH-----GDAYLEVPG	3982
STYLONCHIA	LNNKLNQS-----IGNLGQGYEKLSSTFSEWLDLDFNDF-----YNPSEYIELPG	3800
TRICHINELLA	FLSELRTFY-----IPECCPNLNEYSPWLAGYRPHM-----DVFLEIPG	3554
HETEROSTELIUM	MSGMAKT-----MKPSSATMKLKDFSNWLVEFDRSNQ-----LTEIELPG	3729
GLOMUS	YYIKNIK-----RQDRKAQEGVNLKSYSAWLAEYSSNV-----EKEIEIPG	3655
MOSS	LFEKLSKN-----DISAEKISLGSLSKWLADFDQTKGIERSRDFDKNEMQIEIPG	3646
TERMITE	L-----KYIIQIDIKPPVQLKDYSPWLSEFQGGKH-----CFLELEIPG	3576
SALPINGOECA	LKAKLREY-----DTKKPPRTLKEYSPWLSKYRSPGA-----VFDIEIPG	3771
ROTIFER	ICSQVNEF-----CQRKPMGSLGDYSAWLKGFKR-NI-----TKDIEIPG	3641
SHRIMP	MGRVL-----QLSPEEMRKLPRQLKAYSPWLANFQASKY-----SEVLEIPG	3658
SCORPION	LLKKITT-----MSEMKEAKLRDFSDWLESEFHSIKY-----SEDIEIPG	3689
SPONGE	VYNKMRE-----SLNKFSSSALKDYSPWLDTFRQEDY-----LQVIEVPG	3742
HUMAN	LLLKMN-----KDSKPPGNLKECSPWMSDFKVEFL-----RNELEIPG	3703
ESHARK	IM--ET-----QKPEPPGNLKEYSPWMSNFKPQFL-----GNELEIPG	3718
LIMPET	-----KGRGKLVPPLSLHEYCQWLADFNPNRD-----SRELEIPG	3658
LINGULA	MDLASK-----GTKGHPNLVPSEKLGDYSKWMSGLAAQDM-----DLSLEIPG	3694
TRICHOPLAX	LIQELISG-----KIKNRPENLKEYCPWLSNFOAANF-----TYSIEVPG	3708
STONYCORAL	IQQKMKF-----RNRTPPPGLKEYSPWLSRFQSNNF-----THTLEIPG	3747
STARFISH	-----GKLYKEMAA---KRRDPPGNLKEYSPWLSDFQQLSY-----DRELEIPG	3768
LANCELET	LQNMGMDFYRKAFPREKANCYAPGLLKDYCPWLSDFNPLDY-----DRELEIPG	3778

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Supplementary Figure 4: CLUSTAL All phyla small

APHANOMYCESE	QYIKR-----WAKPDPSTHTYIILSCDPQLMVLPSKQLPKRLKLYASDEKTYLFLVKGGE	3334
FLATWORM	QYQCRDSLATSLAKPQPELHTRIAAGFGDTRVVRMSSLRRPHRLTIRGNDQRDRPYLVKAGE	4042
STYLONCHIA	QYEGE-----KSEPLIEKNVKIASVKKTLILLGSIIRPKRITVHGSNEKDYHLLIKGGE	3854
TRICHINELLA	QYSGD-----RRPFPERHVHIIGFASDIEIMRSLKKPKKICIQGDDGRDYKYLKAGE	3607
HETEROSTELIUM	QYHGT-----SKPQPELHIKISSFDPNLLVMGSLRKPRIKIHGSDQDYPLIKGGE	3782
GLOMUS	QYDGL-----LSIPDPKSHIKIASFDPKLLVLRSLRKPKRITILGTDGNEYLFLVKGGE	3709
MOSS	QYNGS-----SIPNLSHTVQLLGFQVLIICLKSQRPKILTRGSDENDYKFLVKGGE	3699
TERMITE	QYTGE-----SKPLIQHHVKIAGFKQTVVPMKTLRLPLQVTFGSDAKEHQYLKAGE	3629
SALPINGOECA	QYGGT-----EMPIPEEHAKIEGFDEKLLIMASIRRMRLTFRGSDEREYRFLVKGGE	3824
ROTIFER	QYNGN-----EKPMPEYHVKIESFDERILEMSSLRRPKCITIRGDDQREYKFLVKGGE	3694
SHRIMP	QYTMG-----SKPLPEYHVKISSFDENVLLMSSMRVPMRIIRGDDEKEYKFLVKGGE	3711
SCORPION	QYTGK-----RKPIPEHHVKICNFQDQVDILSSLTKPRLTIRGNDQKDYKFLVKSAGE	3742
SPONGE	LYDGR-----SKPLPEYHAKITRFDAKVLILSSLRKPRLTIIGDDTREYMFVKGGE	3795
HUMAN	QYDGR-----GKPLPEYHVRIAGFDERVTVMASLRRPKRIIRGHDEREHPFLVKGGE	3756
ESHARK	QYDGG-----CKPLPEYHAKITGFDERVKVMSSIRKPKRLIIRGNDEKEYPFLVKGGE	3771
LIMPET	QYDGL-----SKPLPEYHVKIVAGFDERVLMSSLRPKRITIRGNDEKDYHFLVKGGE	3711
LINGULA	QYTGK-----SKPMPEYHVKIVAGFDSRVLVLSMRPKRITIRGNDMDKHKFLVKGGE	3747
TRICHOPLAX	QYTRG-----SKPLPEYHLKIASFGERLLVLKSIKPKLRLTVQGDDEKEYLFLVKGGE	3761
STONYCORAL	QYKGG-----TKPLPEYHVKIVGFDEKQVQLPSIRKPKLIIRGDDEKDHMFLVKGGE	3800
STARFISH	QYGGK-----SKPLPEYHVKIVAGFDEKQVQLSSMRPKRIVIRGNDEHDYSFLVKGGE	3821
LANCELET	QYTGK-----VKPLMQYHAKIAGFDQVRVVMSSLRPKRVTIRGDDERDHPFLVKGGE	3831

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ATP binding site

APHANOMYCESE	DLRLDQRIEQFLFGAMNTILQSSNQCSRRH--LNTRTYNVIPMTTKIGLVEWLENTTTLKS	3392
FLATWORM	DLRQDQRIQALGLFNSSLQRDIQCRLRR--LSLVTYQVPLSPDLGILEWLERTQPYKD	4100
STYLONCHIA	DLRLDQRVQQLFQIINSIFKDDAQCNRD--LYIKTFKVVPIITNRLGTLEWVDDTEPMKS	3912
TRICHINELLA	DLRQDERVQQLFDLMNGILKQHQCSRLK--ARIRTYRIVPLSIKLGLEIFLPNVVPLQQ	3665
HETEROSTELIUM	DLRLDQRIEQFLFVMNEILKRDIPATSKRG--LHKTQYQVVPMTGKVGILEWLDNTPKLE	3840
GLOMUS	DLRLDQRVQQLFSLMNGILKKSDFCSQRN--ITQRTYKVVPIITGHLGILEWINNTPMRY	3767
MOSS	DLRLDQRIEQFLFEAMNNVLRDAACSQRK--LAIRTYSVIPVSKKCGLLQFVENTCVLQE	3757
TERMITE	DLRQDQRIEQFLFNLMNKILDQDPTCRHRN--LSITTYQVPLSSHGLIQWVDGTEALKG	3687
SALPINGOECA	DLRTDARMEQLFAVMNQALAADPACGERG--LSLRTYNVVPMTRIGMLEWVPNSCVFKE	3882
ROTIFER	DQRQDQRVIEILLDIINNLLKSDSKCYQRN--LSIKTYQVVPMTSKLALIEWLPEKPLKV	3752
SHRIMP	DLRTDQRMQMFTELMNSIYARSPICTKASSVPSLDTYQVIPLSLRVGILQWVDSTQPLKD	3771
SCORPION	DLRQDSRIEQFLFDMNDIYQCNATCFQNG--LKLETYQVIPLTKIGLEWVDNTNVLGS	3800
SPONGE	DLRLDQRIEQFLFETMNKVLSDDPICSRQR--LNLRTYSVIPVTPRVGLIEWVRNTMPLKD	3853
HUMAN	DLRQDQRVIEQLFQVMNGILAQDSACSQRA--LQLRTYSVVPMTSRLGLIEWLENTVTLKD	3814
ESHARK	DLRQDQRIEQFLFEVMNIIILSRDAACSQRS--LQLKTYQVIPMTSRLGLIEWLDNTCTLKD	3829
LIMPET	DLRQDARIEQLFVIMNKVFDKDPVCRHRK--LHLKTYQVIPMTPRVGLIEWMNNTPPKLD	3769
LINGULA	DLRQDQRIEQFLFYIMNRVFSQDPDCKPRQ--YKLRTYQVIPMTTKVGLIEWVNQTKTLKE	3805
TRICHOPLAX	DLRLDQRIEQFLFCVMNEILAQDSICSQD--LRLRTYQVIPITQRLGLIEWMKNITLKE	3819
STONYCORAL	DLRLDQRIEQFLFGLMNDIMANDSACSQRG--LRLRTYQVIPMTPRVGLIEWMNNTPKPLK	3858
STARFISH	DLRLDQRVIEQLFRIMNSILEQDSTCSQQG--LQLVTYEVIPMTPRGLIEWAQNTPKLE	3879
LANCELET	DLRQDQRIEQFLFIMNDILTLPACSQRQ--LRIRTYQVIPMTSRVGLIEWMONTTPLAG	3889

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APHANOMYCESE	IVEQEMSTTKKS----NLL-----QSPPGQLYENFWSKQ-----RGKTYGQ	3429
FLATWORM	FLVHQMSAAEQRSKSKQ-----SLDYCKFV-----S-----NDHCK	4131
STYLONCHIA	LINREHMRNEAGKD---LN-----QSRALNERRKWLKSSVPGNA--KKEGITDQHI	3958
TRICHINELLA	FFMEESLRKQYQ-----T--IAMEMFTGPEKI---LLKAAGEGS--SPLNHLTYWR	3710
HETEROSTELIUM	IIEDQMAVHQNVRSNVLSL-----RMEAYKIHNEWINSFGKYIKMANPPAGPLYQQ	3892
GLOMUS	FIEREPRTSKV-----FDDAQSMHSRWVQY-----KSYHN	3798
MOSS	VIRGLSSKLASRTHIEGYKPLQATSETLLKEIQHEYIEWVRKKGGG----KSQTECYCN	3812
TERMITE	LMLGVLDKNEKE----SYKK-----SCEEHCKWISKPCNP----QCSFYEKYGE	3728
SALPINGOECA	MINLGMTDAERE----DAKKRKA-----TQLPQNHFSSQFANRFSKD----PSPLKMYSS	3928
ROTIFER	IENDLVNEAQN---NYAE-----FIYGINKDGS--KKTQSEVYGM	3788
SHRIMP	FINDSYRENETK---CYGE--A-----RAL-----YG-K-----NENYT	3799
SCORPION	FLKDAMTDKEKE----SFRE-----SDPKMTFYKFLSKTNS-R--DKSIPLLYEN	3844
SPONGE	FIQLSDPEKK-----SL-----PAASKMNQKWLEQKFGG----SNVNVWYIE	3891
HUMAN	LLLNTMSQEEKA-----AYLS--D-----PRAPPCEYKDWLTKMSGK-----HDV--GAYML	3857
ESHARK	FLSSNITEETQS-----RR-----QDEVLPKYREWLLQKMGAR-----KDMFLRYPT	3870
LIMPET	FVYGALTEQERK---YILG-----DQGPQKHENWTKYKFDK--K--KRCIKSMYQK	3814
LINGULA	VVYGTMTQEKEA---Q-----QKAAILQRNFLSRYGNP--S--DPNICKKYWG	3846
TRICHOPLAX	FVTDAMEDHEKQ---HYLS--S-----QNSPHQLYSKWLKGFSA----GGPVYMYQS	3863
STONYCORAL	VLNSAMTKAEND---HYIG-----PNGAGACYRNWIDKFKGDDR---NPSRFYGE	3902
STARFISH	FLHLMAMTEQEGN---AYNS-----RHGPRYQHSEWVDKYAKG--N--QSNHGVRVYGA	3924
LANCELET	FLENAMTTREQE---AFLH-----QRLPLIDFDAYVHRLGGTVK--NDPWGKVVYGS	3935

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Supplementary Figure 4: CLUSTAL All phyla small

APHANOMYCESE	KIATASSAVTLVVSQAQEMVPMDLIRRHVLNMAQTPAFFQLRETFSTSLAAFNGCSYI	3489
FLATWORM	LYTLSDQVQVQRNFQPLLDVCPDCLLARGLRQLSSSWEAYYAMRDTLVRSHAMCGAHWL	4191
STYLONCHIA	CLLGCDEKIVIEGFNKHKEAIPWYLLRRNGLENCLTSSAFLAIKNQFTKSLATFSIASYL	4018
TRICHINELLA	SFQNIPTETAARCFNEVLKKIPDHLLRDQLLNCCVSPDVFCFLRQKFTVSLASMCIANYL	3770
HETEROSTELIUM	MFMHSDRADAIKKQEKQHDKVPANLLQNGIWAISSSPEYLFIRNSFARSLATFSICSYI	3952
GLOMUS	MFMEVNRDAVVQHFKDLQREISNDMLKKALYKLSSTPEAHLISIRSEFIKCHAVINICGYL	3858
MOSS	LYRKVGFEEVSLKLSALQGQLPMDTLRMGFSRLVTSAESYLAALRSQFARSLSVTSCIGYV	3872
TERMITE	AHMKYSPEETSAEFRKKVNMIPWDMRRALQRLSVSPESYFILRQSFACSYAVLCIAHWL	3788
SALPINGOECA	VMTKAKRSDISRSFLERQALVRPTLLRDALLHLSTTPEAYLTTFRQLFGRTLATMNICQYI	3988
ROTIFER	VYAKYSRELICREFDKIQNSIPWDLFRQFLRTLSSDSEAYFVLRNEFIKSYAVASTCHYI	3848
SHRIMP	VAKKAKRDKVIKAYEEVNVNIPWDLRRGLVRMSSSTEGFFSLRSFAVSYAALCISQWL	3859
SCORPION	IYKI-ADTEVNKKFTECINMIPWDLFRRAFKLFSSSLEAFVILRYNFITSHAVLCISQWL	3903
SPONGE	MYKLLKADEVKKEYRRIVSAVPWDLRRSLISLASTSEFLLRCTFTFIQSLVINICQYI	3951
HUMAN	MYKGANRTETVTSFRKRESKVPADLLKRAFVRMSTPEAFLLALRSHFASHALICISHWI	3917
ESHARK	MYLKASRTETVTAFRTHEQAIPGDLRRRAFIKMSSTTPEAFLLALRSHFASHALMCSHWI	3930
LIMPET	VYQNSRAETIKDFRMKENKVPWDLFRRAFHQMSTSPFAFHVLRCELVVTHATISICQYF	3874
LINGULA	MYERCSRTEAVKSCQDKENSLPWLDRRAAYLQMSSTPEFTYTLRRHFATSHALLCICHYI	3906
TRICHOPLAX	MYRKAKRSEVENHFKFRENSVPWDLRRGFVALSASSEAYLMLRSHFARTHATVSIHYI	3923
STONYCORAL	MFKKANRTETERSFTQKQALVPWDLRRAFQLAVSPEAFFILRSHFASHACLICQYI	3962
STARFISH	VYRHANYTDTVKCFRSWEALVPWDLRRRAFIQLSASPEAFLLRSHFARSHAVICICQYV	3984
LANCELET	LYQKASRTDVTLAFRQVQSKVTWDMRRGYLQMSSCPEAFLLRSHFTTTHATLCIAQYV	3995
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APHANOMYCESE	LGI DRHLDN FLLDYITGTVV GIDFG ISFGSGASMLPV PELVPRFR TRQLQGVLPHN-A	3548
FLATWORM	LSV DRHMSNY MLCLDSGKMI GIDFG YAFGTATIFLPT PELVPRFR LTRQICGAMGPLPPS	4251
STYLONCHIA	IGI DRHLEN FLLDTSDE ELGIDFG IAGSGSIQ-LGI PELMPFR LTRQIEGVIAPHP-L	4076
TRICHINELLA	LEI DRHLEN IVLDTKT GEVIGIDFG YAFGASLQYLPI PELMPFR LTRQFVGVVDVPG-M	3829
HETEROSTELIUM	IGI DRHLEN FLLSQKDGIL GIDFG HAFGTAT Q FLPI PELMPFR LTRQFTSFLMPLD-S	4011
GLOMUS	IGI DRHLEN FLVDTTK GLSISIDFG HAFGSAT ETLNI PELIP FR LTRQIETLMEPLG-S	3917
MOSS	AGV DRHLCN TLVDMRT GALVPIDFG YSFGTNNVLLLPV PELVPR LTAQLKNFLLPLT-A	3931
TERMITE	LGI DRHLSN ILVSVKDGRCV GIDFG SAGTAT Q FLPV PELMPFR LTPHIVSLLQPLE-E	3847
SALPINGOECA	LGI DRHLSN MI DLRT GVVIGIDFG HNFPSAT Q ELPI PEMIPFR LTKQLEAVFLPHK-K	4047
ROTIFER	LGI DRHLSN MI DLKT GRAIGIDFG IAGFHAMNIPV PELVIR LTRQILKLIAPLE-Q	3907
SHRIMP	LGI DRHCSN SLVSLKT GRVIGIDFG HHPESAV Q FLPV PELMPFR LSPIVNVFQPIG-Q	3918
SCORPION	LGI DRHHTGN FLVSTTT GIEVIGIDFG HAFGTAT Q FLPI PELVPR LTRQYLNLMPLK-E	3962
SPONGE	LGI DRHLSN FMVDMET GVVIGIDFG HAFGSAT Q FLPL PELMPFR LTRQFVNLLPLHK-V	4010
HUMAN	LGI DRHLSN FMV AMETGVVIGIDFG HAF GSATQ FLPVPELMPFR LTRQFINLMLPMK-E	3976
ESHARK	LGI DRHLSN FMVNLET GMVIGIDFG HAFGSAT Q FLPV PELMPFR LTRQILNLMPLK-E	3989
LIMPET	LGI DRHLSN FMINLKT GMVIGIDFG HNFPSAT Q FLPV PELMPFR LTRQIINLTLPLG-I	3933
LINGULA	LGI DRHLSN FMVDET GMVIGIDFG HAFGSAT Q FLPV PELMPIR LTRQILNVMMPLR-E	3965
TRICHOPLAX	LGI DRHLSN FMIDRLT GMVIGIDFG HAFGSAT Q FLPL PELMPFR LTRQMLNLMPLR-E	3982
STONYCORAL	LGI DRHLSN FLVDMET GMVIGIDFG HAFGSAT Q FLPL PELMPFR LTRQFVNLMPLK-K	4021
STARFISH	LGI DRHLSN FLISLKT GMVIGIDFG HAFGSAT Q FLPV PELMPFR LTRQIVNLMPLFK-K	4043
LANCELET	LGI DRHLSN FMIDLES GMVIGIDFG HAFGSAT Q HLPV PELMPFR LTRQMLNLLPLK-E	4054
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Active site Mg²⁺ binding site
DXXXXN DFG T3950

APHANOMYCESE	KLLFQQDLAAVLEALRGQHRIESVMSVFLNEPILLEWQVTVKKSRRDKD-----	3598
FLATWORM	QGAFVRCGLGHCLAALRRERELVLSVLQVFINVSAADWKQLAGMLTAAHRESSAAWDTSEH	4311
STYLONCHIA	EGVYKQTMVHALNALKHKRSLIMDTCEIFVKEP LLDWV KDAKQRQKNGENNDNGMV----	4132
TRICHINELLA	HGLESTMKYCLKAFRDSSYILLNTMDTFVKEP SLNWI VEARRQIGEGRT-----	3879
HETEROSTELIUM	VGLLSHNMHTLTAIQNNKDFLLSTMDV FVKEP LIDWIKLASRLGKEQ-----	4059
GLOMUS	KGLLEYPMIKILQIMQANKDILLNSMID FVKEP LLDWLNRANDQAKQKDRNSNE----	3972
MOSS	VGLLRSDMVRIMTALRGSRLISAVMEV FVKEP LVDRQEAVKLQRRARARDVSK-----	3985
TERMITE	TGLFRETMIHCLRTLNNYDMLLATMEV FVQEPS LDWLEFASRHESLN-----	3895
SALPINGOECA	EGLVQEVMVHVLRALKANQRL LLSTMDVFIKEP SL EWQQAR -----	4089
ROTIFER	RGLFESSMVHCLKALRENNDLVLCILD VFIKEP SIDWIGSAVKIAKKN-----L----	3956
SHRIMP	VGMLKEIMVSALGALQESRHVLTAVLE AFVKEP TKDWLDFVQKQEGDT-----	3966
SCORPION	KGVI EATMISALSAL RDNADILLNTMD IFIKEP TVNNQENALKQKRIIGKVDENV----	4017
SPONGE	SGQLRSCMIHTLRALRHSPTLLNTMD VFIKEP SL EWESNAKQ ALAQ-----	4058
HUMAN	TGLMYSIMVHALRAF RS D PGL LNTMDVFIKEP SL DFWKN FEQKMLKKG-----	4024
ESHARK	SGLIRSIMVHGLRAF RLDP LLSTMD IFVKEP SL DWKN LELKQMKKG-----	4037
LIMPET	KGLLENTMIHTTRALRQDYDLLVNTMD VFIKEP SV DWLN F AEKQ RNEM-----	3981
LINGULA	KGLIESTMVHALRALRANYDLLNTMD VFKD LS VDWLA FAEKQLQTT-----	4013
TRICHOPLAX	NGQLKCSMVHTLRALRNKPDLLVNTMD VFIKEP SL DWQN FANRQNAKQ-----	4030
STONYCORAL	SGTLQSVMIHTLRALRSNHDL LLNTMDVFIQEP SL DWQV YARKQAKTQ-----	4069
STARFISH	EGILQSSMVHTLRALRQNHELLINNTMD VFIKEP SL DWKT NASKQAKAQKQDAGRVL----	4098
LANCELET	SGLLQSTMVHVLRALRSPNVLLINNTMD VFIKEP HL DWKN FAAKQMD-----	4100
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