A

Tree scale: 0.1

TDEF MADBUB
PCAR MADBUB
SPOM BUB *
EINT MADBUB
SPOM MAD *
YLIP MADBUB
DHAN MADBUB
CGLA BUB
SCER BUB
SCER MAD
CGLA MAD
KLAC MADBUB
AGOS MADBUB
RIRR MADBUB
NCRA MADBUB
RMIC MAD
*
PBLA MAD
MCIR MAD
CNEO MADBUB
MLAR BUB
MLAR MAD
PBLA BUB
*
RMIC BUB
MCIR BUB
SPUN MADBUB
BDEN MADBUB
MELO MADBUB
MVER MADBUB
UMAY MADBUB
WMEL MADBUB
RSOL MADBUB
PSTI BUB
GLUX BUB
ABIS BUB
EGLA MADBUB
PSTI MAD
ABIS MAD
GLUX MAD
CPAR MADBUB
MSPE MADBUB
BPRA MADBUB
OLUC MADBUB
OTAU MADBUB
CVAR MADBUB
CSUB MADBUB
VCAR MADBUB
CREI MADBUB
MPOL MADBUB
PPAT MAD
KFLA MADBUB
PPAT BUB
SMOE MAD
OSAT MAD
ATRI MAD
ATHA MAD
ACOE MAB
SMOE BUB
ATRI BUB B
OSAT BUB B
ATHA BUB B
ACOE BUB B
ATRI BUB A
ATHA BUB A
OSAT BUB A
ACOE BUB A
SARC MADBUB
PBRA MADBUB
NGRU MAD *
GTHE MADBUB
TTRA MADBUB
PPAL MADBUB
DDIS MADBUB
COWC MADBUB
ACAS MADBUB
SMIN MADBUB
EHUX MADBUB
CMER MADBUB
PPUR MADBUB
GSUL MADBUB
AKER MADBUB
ALIM MADBUB
ALAI MAD
ALAI BUB1
HPAR MADBUB
PINF MADBUB
BHOM MADBUB
TPSE MADBUB
PTRI MADBUB
ESIL MAD *
NGAD MADBUB
AANO BUB
AANO MAD
NVEC MADBUB
NGRU BUB *
SMAN MADBUB
MLEI MADBUB
ESIL BUB *
MBRE MADBUB
SROS MADBUB
TADH MADBUB
CGIG MADBUB
CTEL MADBUB
SPUR MADBUB
LANA MADBUB
BFLO MADBUB
SKOW MADBUB
PCAU MADBUB
OBIM MADBUB
SMIM MADBUB
ZNEV MADBUB
NVIT MADBUB
ACYR MADBUB
BMOR MADBUB
DMEL MAD
AGAM MAD
AGAM BUB
DMEL BUB
LSAL MADBUB
CCOR MADBUB
DMAG MADBUB
BMAL MAD
ACEY MAD
CELE MAD
SBAT MAD
SBAT BUB
BMAL BUB
CELE BUB
ACEY BUB
CINT MADBUB
CMIL BUB
LOCU BUB
DRER BUB
TRUB BUB
XTRO BUB
FALB BUB
ACAR BUB
MMUS BUB
HSAP BUB
LOCU MAD
DRER MAD A
TRUB MAD
LAMPREY MADBUB
CMIL MAD
XTRO MAD
ACAR MAD
FALB MAD
HSAP MAD
MMUS MAD

B

Amoebozoa
ACAS MADBUB
DDIS MADBUB
PPAL MADBUB
TTRA MADBUB
EINT MADBUB
fungi
CCOR MADBUB
BDEN MADBUB
SPUN MADBUB
MELO MADBUB
MVER MADBUB
MCIR BUB
PBLA BUB
RMIC BUB
mucorales 1
MCIR MAD
PBLA MAD
RMIC MAD
RIRR MADBUB
TDEF MADBUB
PCAR MADBUB
taphrinomycotina
3
SPOM MAD
SPOM BUB
ascomycetes
NCRA MADBUB
YLIP MADBUB
DHAN MADBUB
AGOS MADBUB
KLAC MADBUB
SCER MAD
saccharomycetes
2
CGLA MAD
SCER BUB
CGLA BUB
WMEL MADBUB
UMAY MADBUB
4
MLAR BUB
MLAR MAD
basidiomycetes
CNEO MADBUB
EGLA MADBUB
RSOL MADBUB
ABIS BUB
agaricomycetes
GLUX BUB
5
PSTI BUB
ABIS MAD
GLUX MAD
PSTI MAD
Opisthokonts
saccharomycetes
SARC MADBUB
COWC MADBUB
choanoflagellates
MBRE MADBUB
SROS MADBUB
TADH MADBUB
AQUE MADBUB
MLEI MADBUB
NVEC MADBUB
SKOW MADBUB
SPUR MADBUB
BFLO MADBUB
metazoa
CINT MADBUB
LAMPREY MADBUB
CMIL BUB
LOCU BUB
DRER BUB
TRUB BUB
XTRO BUB
HSAP BUB
MMUS BUB
ACAR BUB
FALB BUB
vertebrates
?
6
CMIL MAD
LOCU MAD
DRER MAD B
DRER MAD A
7
TRUB MAD
loss of teleost MAD B
XTRO MAD
HSAP MAD
MMUS MAD
ACAR MAD
FALB MAD
lophotrochozoa
SMAN MADBUB
CTEL MADBUB
OBIM MADBUB
LANA MADBUB
CGIG MADBUB
scalidophores
PCAU MADBUB
protostomes
CELE MAD
BMAL MAD
ACEY MAD
SBAT MAD
nematodes
8
CELE BUB
BMAL BUB
ecdysozoa
ACEY BUB
SBAT BUB
SMIM MADBUB
DMAG MADBUB
LSAL MADBUB
arthropods
ZNEV MADBUB
ACYR MADBUB
insects
NVIT MADBUB
BMOR MADBUB
DMEL MAD
AGAM MAD
9
DMEL BUB
diptera
AGAM BUB
Archeaplastids
CPAR MADBUB
rhodophytes (red algae)
PPUR MADBUB
CMER MADBUB
GSUL MADBUB
CREI MADBUB
VCAR MADBUB
CSUB MADBUB
CVAR MADBUB
chlorophytes (green algae)
MSPE MADBUB
BPRA MADBUB
OLUC MADBUB
OTAU MADBUB
KFLA MADBUB
MPOL MADBUB
bryophytes
PPAT BUB
13
PPAT MAD
viridiplantae
SMOE MAD
ATRI MAD
?
embryophytes
(land plants)
OSAT MAD
ATHA MAD
14
ACOE MAD
tracheophytes
(vascular plants)
SMOE BUB
ATRI BUB A
OSAT BUB A
ATHA BUB A
ACOE BUB A
15
ATRI BUB B
magnoliaphytes
(flowering plants)
OSAT BUB B
ATHA BUB B
ACOE BUB B
PBRA MADBUB
rhizaria
BNAT MADBUB A
SAR
BNAT MADBUB B
alveolata
SMIN MADBUB
BHOM MADBUB
ALIM MADBUB
AKER MADBUB
stramenopiles
PINF MADBUB
HPAR MADBUB
oomycetes
ALAI BUB
10
ALAI MAD
AANO MAD
12
AANO BUB
aureococcus
PTRI MADBUB
?
diatoms
TPSE MADBUB
NGAD MADBUB
ESIL BUB
brown algae
11
ESIL MAD
Excavata
16
NGRU MAD
NGRU BUB
cryptophytes
GTHE MADBUB
haptophytes
EHUX MADBUB

pseudo

Tetratrico peptide repeat (TPR)
KEN box 1 (KEN 1)
KEN box 2 (KEN 2)
Other KEN boxes
Destruction box (Dbox)
MAD-associated Motif (MadaM)
ABBA motif (A motif)
Kinase domain
Conserved motif I (CMI)
GLE2 - binding sequence (GLEBS)
Kinetochore attachment regulatory domain (KARD)
Conserved domain II (CDII)

duplication
highly probable
uncertain

bootstrap
1
100

duplication associated *

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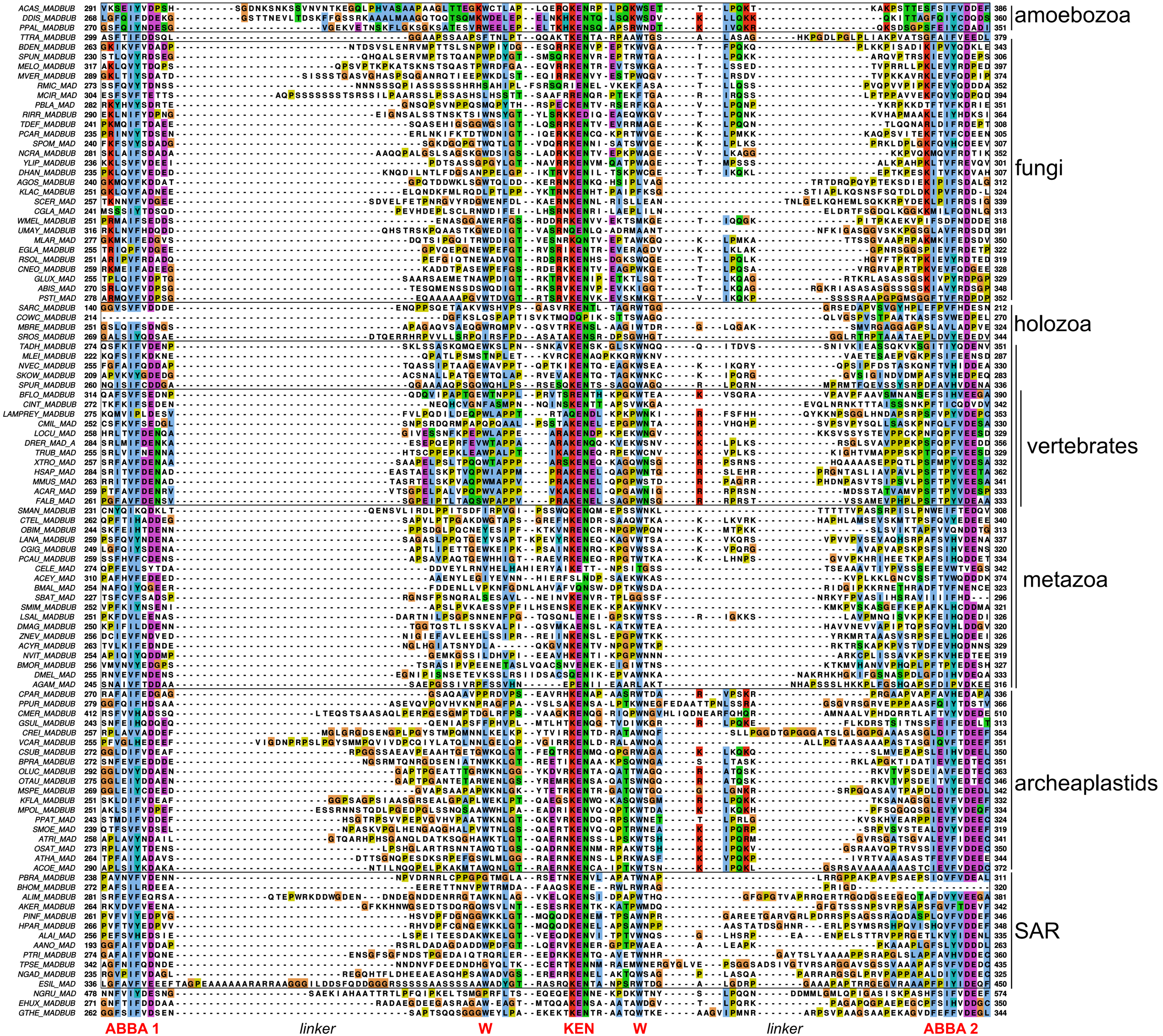
Supplementary Figure 1

Supplementary file 2



Supplementary table I

Taxonomy				Species ID	Species name
amoeba	longamoebia			ACAS	*Acanthamoeba castellanii*
	dictyostelia			DDIS	*Dictyostelium discoideum*
				PPAL	*Polysphondylium palidum*
apusomonadida				TTRA	*Thecamonas trahens*
opisthokonta	ichtyosporea			SARC	*Sphaeroforma arctica*
	filasterea			COWC	*Capsaspora owczarzaki*
	choanoflagellida			MBRE	*Monosiga brevicollis*
				SROS	*Salpingoeca rosetta*
	metazoa	chordata	vertebrata	LAMPREY	*Petromyzon marinus*
				CMIL	*Callorhinchus milii*
				LOCU	*Lepisosteus oculatus*
				DRER	*Danio rerio*
				TRUB	*Takifugu rubripes*
				FALB	*Ficedula albicollis*
				ACAR	*Anolis carolinensis*
				HSAP	*Homo sapiens*
				MMUS	*Mus musculus*
				XTRO	*Xenopus tropicalis*
			cephalochordata	BFLO	*Branchiostoma floridae*
			tunicata	CINT	*Ciona intestinales*
		echinodermata		SPUR	*Strongylocentrotus purpuratus*
		hemichordata		SKOW	*Saccoglossus kowalevskii*
		annelida		CTEL	*Capitella teleta*
		brachiopoda		LANA	*Lingula anatina*
		mollusca		CGIG	*Crassostrea gigas*
				OBIM	*Octopus bimaculoides*
		platyhelmithes		SMAN	*Schistosoma mansoni*
		vinctiplicata		PCAU	*Priapulus caudatus*
		nematoda	rhabditida	CELE	*Caenorhabditis elegans*
				ACEY	*Ancylostoma ceylanicum*
			spirurida	BMAL	*Brugia maly*
			ascaridida	SBAT	*Soboliphyme baturini*
		arthropoda	insecta	DMEL	*Drosophila melanogaster*
				AGAM	*Anopheles gambiae*
				BMOR	*Bombyx mori*
				NVIT	*Nasonia vitripennis*
				ACYR	*Acyrthrosiphon pisum*
				ZNEV	*Zootermopsis nevadensis*
			crustacea	LSAL	*Lepeophtheirus salmonis*
				DMAG	*Daphnia magna*
			arachnida	SMIM	*Stegodyphus mimosarum*
		cnidaria		NVEC	*Nematostella vectensis*
		placozoa		TADH	*Trichoplax adhaerens*
		ctenophora		MLEI	*Mnemiopsis leidiyi*
		porifera		AQUE	*Amphimedon queenslandica*
	fungi	microsporidia		EINT	*Encephalitozoon intestinalis*
		chytridiomycota		BDEN	*Batrachochytrium dendrobatidis*
				SPUN	*Spizellomyces punctatus*
		mucorales		RMIC	*Rhizopus microsporus*
				MCIR	*Mucor circinelloides*
				PBLA	*Phycomyces blakesleeanus*
		mortierellaceae		MVER	*Mortierella verticillata*
				MELO	*Mortierella elongata*
		glomeromycota		RIRR	*Rhizophagus irregularis*
		entomophtorales		CCOR	*Conidiobolus coronatus*
		basidiomycota	ustilaginomycotes	UMAY	*Ustilago maydis*
			wallemiomycetes	WMEL	*Wallemia mellicola*
			pucciniomycetes	MLAR	*Melampsora larici-populina*
			tremellomycetes	CNEO	*Cryptococcus neoformans*
			agaricomycetes	RSOL	*Rhizoctonia solani*
				EGLA	*Exidia glandulosa*
				PSTI	*Punctularia strigosozonata*
				ABIS	*agaricus bisporus*
				GLUX	*Gymnopus luxurians*
		ascomycota	taphrinomycotina	PCAR	*Pneumocystis carinii*
				TDEF	*Taphrina deformans*
				SPOM	*Schizosaccharomyces pombe*
			pezizomycetes	NCRA	*Neurospora crassa*
			saccharomycetes	YLIP	*Yarrowia lipolytica*
				DHAN	*Debaryomyces hansenii*
				KLAC	*Kluyveromyces lactis*
				AGOS	*Ashbya gossipii*
				CGLA	*Candida glabrata*
				SCER	*Saccharomyces cerevisiae*
archeaplastida	glaucophyta			CPAR	*Cyanophora paradoxa*
	rhodophyta		cyanidales	GSUL	*Galdieria sulphuraria*
				CMER	*Cyanidioschyzon merolae*
			porphyridiales	PPUR	*Porphyridium purpureum*
	viridiplantae	chlorophyta	mamiellophyceae	BPRA	*Bathycoccus prasinos*
				MSPE	*Micromonas species*
				OLUC	*Ostreococcus lucimarinus*
				OTAU	*Ostreococcus tauri*
			chlorophyceae	CREI	*Chlamydomonas reinhardtii*
				VCAR	*Volvox carteri*
			trebouxiophyceae	CVAR	*Chlorella variabilis*
				CSUB	*Coccomyxa subellipsoidea*
		klebsormidiophyta		KFLA	*Klebsormidium flaccidum*
		embryophyta	marchantiophyta	MPOL	*Marchantia polymorpha*
			bryophyta	PPAT	*Physcomitrella patens*
			lycopodiophyta	SMOE	*Selaginella moellendorffii*
			magnoliaphyta	ATRI	*Amborella trichopoda*
				OSAT	*Oryza sativa japonica*
				ATHA	*Arabidopsis thaliana*
				ACOE	*Aquilegia coerulea*
excavata	heterolobosoea			NGRU	*Naegleria gruberi*
SAR	stramenopiles	blastocystis		BHOM	*Blastocystis hominis*
		labyrinthulomycetes		AKER	*Aplanochytrium kerguelense*
				ALIM	*Aurantiochytrium limacinum*
		oomycetes		ALAI	*Albugo laibachii Nc*
				PINF	*Phythophthora infestans*
				HPAR	*Hyaloperonospora parasitica*
		eustigmatales		NGAD	*Nannochloropsis gaditana*
		pelagophyceae		AANO	*Aureococcus anophagefferens*
		phaephyceae		ESIL	*Ectocarpus siliculosus*
		diatomea		PTRI	*Phaeodactylum tricornutum*
				TPSE	*Thalassiosira pseudonana*
	rhizaria	plasmodiophoromycetes		PBRA	*Plasmodiophora brassicae*
		cercozoa		BNAT	*Bigelowiella natans*
	alveolata	chlorarachniophyta		SMIN	*Symbiodinium minutum*
haptophyta				EHUX	*Emiliania huxleyi*
cryptophyta				GTHE	*Guillardia theta*

Supplementary table II

eukaryotic supergroup	Species ID	ID|type	TPR	MAD-like							BUB-like						
				KEN1	ABBA1	KEN2	ABBA2	Dbox	MadaM	GLEBS	CMI	ABBA other	KARD	KEN other	CDII	kinase
amoeba	ACAS	ACAS_MADBUB	1	1	1	1	1	1		1	1	4		3	1	1
	DDIS	DDIS_MADBUB	1	1	1	1	1	1	1	1	1	3		2	1	1
	PPAL	PPAL_MADBUB	1	1	1	1	1	1	1	1	1	6		1	1	1
unknown	TTRA	TTRA_MADBUB	1	1	1	1	1	1	1	1	2	6				1
opisthokonta	SARC	SARC_MADBUB	1		1	1	1	1	1	1	1	2		2		
	COWC	COWC_MADBUB	1			1	1			1					1	1
	MBRE	MBRE_MADBUB	1	1	1	1	1	2		1	1	3	2		1	1
	SROS	SROS_MADBUB	1	1	1	1	1	2		1	1	1	1	1	1	1
	LAMPREY	LAMPREY_MADBUB	1	1	1	1	1	1		1			1		1	1
	CMIL	*CMIL_BUB*	1							1	1	1		1	1	1
		CMIL_MAD	1	1	1	1	1	3		1	1	1	1		1	1
	LOCU	*LOCU_BUB*	1							1	1	1		1	1	1
		LOCU_MAD	1	1	1	1	1	2		1		2	1	3		1
	DRER	*DRER_BUB*	1							1	1	2	1		1	1
		DRER_MAD_A	1	1	1	1	1	1		1						
		DRER_MAD_B						1		1		4	1			1
	TRUB	*TRUB_BUB*	1							1	1	2	1	1	1	1
		TRUB_MAD	1	1	1	1	1	1		1						
	FALB	*FALB_BUB*	1							1	1	1		2	1	1
		FALB_MAD	1	1	1	1	1	2		1		2	1		1	1
	ACAR	*ACAR_BUB*	1							1	1	1		1	1	1
		ACAR_MAD	1	1	1	1	1	1		1		1	1	1	1	1
	HSAP	*HSAP_BUB*	1							1	1	2	1	2	1	1
		HSAP_MAD	1	1	1	1	1	2		1		1	1		1	1
	MMUS	*MMUS_BUB*	1							1	1	1	1	3	1	1
		MMUS_MAD	1	1	1	1	1	2		1		1	1		1	1
	XTRO	*XTRO_BUB*	1							1	1	1	1	1	1	1
		XTRO_MAD	1	1	1	1	1	2		1		1	1		1	1
	BFLO	BFLO_MADBUB	1	1	1	1	1	2		1	1	1	1	2	1	1
	CINT	CINT_MADBUB	1	1	1	1	1	2		1	1	4	1		1	1
	SPUR	SPUR_MADBUB	1	1	1	1	1	2		1	1	7	1	1	1	1
	SKOW	SKOW_MADBUB	1		1	1	1	1		1	1	1	1	2	1	1
	CTEL	CTEL_MADBUB	1	1	1	1	1	1		1	1	2	1	1	1	1
	LANA	LANA_MADBUB	1	1	1	1	1	3		1	1	4	1	1	1	1
	CGIG	CGIG_MADBUB	1	1	1	1	1	1		1	1	2	1	1	1	1
	OBIM	OBIM_MADBUB	1	1	1	1	1	1		1	1	1	1		1	1
	SMAN	SMAN_MADBUB	1	1	1	1	1									
	PCAU	PCAU_MADBUB	1	1	1	1	1	2		1	1	3	1	1	1	1
	CELE	*CELE_BUB*	1							1		2			1	1
		CELE_MAD	1	1	1		1	1		1						
	ACEY	*ACEY_BUB*	1					1		1		1			1	1
		ACEY_MAD	1	1	1		1	1		1				1		
	BMAL	*BMAL_BUB*	1									2			1	1
		BMAL_MAD	1	1	1		1	1		1						
	SBAT	*SBAT_BUB*	1									2			1	1
		SBAT_MAD	1	1	1	1	1	1		1						
	DMEL	*DMEL_BUB*	1							1				3	1	1
		DMEL_MAD	1	1	1	1	1	1		2		3	1	2	1	1
	AGAM	*AGAM_BUB*	1							1					1	1
		AGAM_MAD	1	1	1	1	1	1		2		2	1	2	1	1
	BMOR	BMOR_MADBUB	1	1	1	1	1	1		1	1	1	1	2	1	1
	NVIT	NVIT_MADBUB	1	1	1	1	1	1		1	1	2	1	2	1	1
	ACYR	ACYR_MADBUB	1	1	1	1	1	1		1	1	5	1		1	1
	ZNEV	ZNEV_MADBUB	1	1	1	1	1	3		2	1	2	1	7	1	1
	LSAL	LSAL_MADBUB	1	1	1	1	1	1		1		3	1	1	1	1
	DMAG	DMAG_MADBUB	1	1	1	1	1	3		2	1	2	1	2	1	1
	SMIM	SMIM_MADBUB	1	1	1	1	1	2		1		3	1		1	1
	NVEC	NVEC_MADBUB	1	1	1	1	1	2		2	1	3	1	1	1	1
	TADH	TADH_MADBUB	1	1	1	1	1	2		1		2	1	2	1	1
	MLEI	MLEI_MADBUB	1	1	1	1	1			1		3	1		1	1
	AQUE	AQUE_MADBUB						11		1		10	1	1	1	1
archeaplastida	EINT	EINT_MADBUB	1							1						
	BDEN	BDEN_MADBUB	1	1	1	1	1	1		1	1	2	1		1	1
	SPUN	SPUN_MADBUB	1	1	1	1	1	1		1	1	1	1	1	1	1
	RMIC	*RMIC_BUB*	1							1					1	1
		RMIC_MAD	1	1	1	1	1	1		1						
	MCIR	*MCIR_BUB*	1							1					1	1
		MCIR_MAD	1	1	1	1	1	1		1						
	PBLA	*PBLA_BUB*	1							1						1
		PBLA_MAD	1	1	1	1	1	1		1						
	MVER	MVER_MADBUB	1	1	1	1	1	1		2	1					
	MELO	MELO_MADBUB	1	1	1	1	1	1		1	1					
	RIRR	RIRR_MADBUB	1	1	1	1	1	1		1	1		1		1	1
	CCOR	CCOR_MADBUB	1	1						1		2				
	UMAY	UMAY_MADBUB	1	1	1	1	1	1	1	1	1		1		1	1
	WMEL	WMEL_MADBUB	1	1	1	1	1	1	1	1	1	1	1		1	1
	MLAR	*MLAR_BUB*	1						1	1	1	1	1		1	1
		MLAR_MAD	1	1	1	1	1	1	1							
	CNEO	CNEO_MADBUB	1	1	1	1	1	1	1	1	1	2	1		1	1
	RSOL	RSOL_MADBUB	1	1	1	1	1	1	1		1	5	1		1	1
	EGLA	EGLA_MADBUB	1	1	1	1	1	1	1	1	1	7	1		1	1
	PSTI	*PSTI_BUB*	1					1		1	1	7	1	1	1	1
		PSTI_MAD	1	1	1	1	1	1	1			2				
	ABIS	*ABIS_BUB*	1					1		1	1	5	1		1	1
		ABIS_MAD	1	1	1	1	1	1	1			2				
	GLUX	*GLUX_BUB*	1							1	1	4	1		1	1
		GLUX_MAD	1	1	1	1	1	1	1			2				
	PCAR	PCAR_MADBUB	1	1	1	1	1	1		1	1		1		1	1
	TDEF	TDEF_MADBUB	1	1	1	1	1	1		1	1	1	1		1	1
	SPOM	*SPOM_BUB*	1				1	1		1	1		1		1	1
		SPOM_MAD	1	1	1	1	1									
	NCRA	NCRA_MADBUB	1	1	1	1	1	2		1	1		1		1	1
	YLIP	YLIP_MADBUB	1	1	1	1	1	1		1	1		1		1	1
	DHAN	DHAN_MADBUB	1	1	1	1	1	1		1	1		1		1	1
	KLAC	KLAC_MADBUB	1	1	1	1	1			1	1	1	1		1	1
	AGOS	AGOS_MADBUB	1	1	1	1	1			1	1	1	1		1	1
	CGLA	*CGLA_BUB*	1							1	1	1	1		1	1
		CGLA_MAD	1	1	1	1	1	1		1						
	SCER	*SCER_BUB*	1							1	1	3	1	1	1	1
		SCER_MAD	1	1	1	1	1	1		1		1				
archeaplastida	CPAR	CPAR_MADBUB	1	1	1	1	1	1		1						
	GSUL	GSUL_MADBUB	1	1	1	1	1	1			1	1				
	CMER	CMER_MADBUB	1	1	1	1	1	1			1		1	1		
	PPUR	PPUR_MADBUB	1	1	1	1	1				1					
	BPRA	BPRA_MADBUB	1	1	1	1	1			1	1	1		2	1	1
	MSPE	MSPE_MADBUB	1	1	1	1	1			1	1	4			1	1
	OLUC	OLUC_MADBUB	1	1	1	1	1			1	1				1	1
	OTAU	OTAU_MADBUB	1	1	1	1	1			1	1				1	1
	CREI	CREI_MADBUB	1	1	1	1	1	1		1	2	2				
	VCAR	VCAR_MADBUB	1	1	1	1	1	1		1	2	2				
	CVAR	CVAR_MADBUB	1	1						1	4	2		1	1	1
	CSUB	CSUB_MADBUB	1	1	1	1	1	1		1	3	8		3		
	KFLA	KFLA_MADBUB	1	1	1	1	1	1	1	1	1	2			1	1
	MPOL	MPOL_MADBUB	1	1	1	1	1			1	1	4		1	1	1
	PPAT	*PPAT_BUB*	1							1	4	2			1	1
		PPAT_MAD	1	1	1	1	1		1	1	1	11				
	SMOE	*SMOE_BUB*	1								1	2		1	1	1
		SMOE_MAD	1	1	1	1	1		1							
	ATRI	*ATRI_BUB_A*	1												1	1
		ATRI_BUB_B	1								4	4				
		ATRI_MAD	1	1	1	1	1		1							
	OSAT	*OSAT_BUB_A*	1												1	1
		OSAT_BUB_B	1								3	5		1		
		OSAT_MAD	1	1	1	1	1		1							
	ATHA	*ATHA_BUB_A*	1												1	1
		ATHA_BUB_B	1								3	3		1		
		ATHA_MAD	1	1	1	1	1		1					1		
	ACOE	*ACOE_BUB_A*	1												1	1
		ACOE_BUB_B	1								3	3				
		ACOE_MAD	1	1	1	1	1		1							
excavata	NGRU	*NGRU_BUB*	1							1		1			1	1
		NGRU_MAD	1	1	1	1	1	1								
SAR	BHOM	BHOM_MADBUB	1	1	1	1				1		2		1		
	AKER	AKER_MADBUB	1	1	1	1	1	1	1		1	4				
	ALIM	ALIM_MADBUB	1	1	1	1	1		1		1	3				
	ALAI	*ALAI_BUB*	1							1				1	1	1
		ALAI_MAD	1	1	1	1	1	1	1	1	1	1				
	PINF	PINF_MADBUB	1	1	1	1	1	1	1	1	1	4				1
	HPAR	HPAR_MADBUB	1	1	1	1	1	1	1	1	1	2				1
	NGAD	NGAD_MADBUB	1	1	1	1	1		1			1				1
	AANO	*AANO_BUB*	1					1		1	1	4				
		AANO_MAD	1	1	1	1	1									
	ESIL	*ESIL_BUB*	1												1	1
		ESIL_MAD	1	1	1	1	1	1			1					
	PTRI	PTRI_MADBUB	1	1	1	1	1	1	1	1	1	4				1
	TPSE	TPSE_MADBUB	1	1	1	1	1	1	1	1	1	4				1
	PBRA	PBRA_MADBUB	1	1	1	1	1	1		1	1	1				1
	BNAT	BNAT_MADBUB_A	1	1												
		BNAT_MADBUB_B								1	1	2	1	1	1	1
	SMIN	SMIN_MADBUB	1	1	1											
unknown	EHUX	EHUX_MADBUB	1	1	1	1	1	1		1	2	5				
	GTHE	GTHE_MADBUB	1	1	1	1	1			1	4	2	1	1		1

Supplementary table III

mutant	5'-3' sequence	orientation
dABBA1	CCATTTCCTCAACAGATGCAAAATAATAGTGCTGATGAGGCTTCTACAGCAGAGTTGTCT	FW
dABBA1	AGACAACTCTGCTGTAGAAGCCTCATCAGCACTATTATTTTGCATCTGTTGAGGAAATGG	RV
dABBA2	TCACTGATAGCTGTACCCGCTGTGCTTCCCACTGCACAACAGCCAGTTATGACACCATGT	FW
dABBA2	ACATGGTGTCATAACTGGCTGTTGTGCAGTGGGAAGCACAGCGGGTACAGCTATCAGTGA	RV
W1A	CAGTCCAGCCAgcGATAGCACCCCCC	FW
W1A	GGGGGGTGCTATCgcTGGCTGGACTG	RV
W2A	GCAAGCAGGCCCTGCGAACACAGGCAGG	FW
W2A	CCTGCCTGTGTTCGCAGGGCCTGCTTGC	RV
KEN1-AAA	GATGAATGGGAACTGAGTGCAGCAGCTGTACAACCTTTAAGGCAAGG	FW
KEN1-AAA	CCTTGCCTTAAAGGTTGTACAGCTGCTGCACTCAGTTCCCATTCATC	RV
KEN2-AAA	CCATGCCCAGGGCAGCGGCTAGCGAGCTGCAAGC	FW
KEN2-AAA	GCTTGCAGCTCGCTAGCCGCTGCCCTGGGCATGG	RV
dDBOX	GAGTCTTCTGTACCACAAAAGAGCAAAGGGAAAAAGACAGC	FW
dDBOX	GCTGTCTTTTTCCCTTTGCTCTTTTGTGGTACAGAAGACTC	RV
dABBA3	GGTCCCAGTGTACCTTTTCTTCTTTCAGAAAAGAAG	FW
dABBA3	CTTCTTTTCTGAAAGAAGAAAAGGTACACTGGGACC	RV