

Table 1. Number of large adaptin subunits present in diverse eukaryotic genomes

Taxon	$\gamma\alpha\delta\epsilon$	
	$\beta_1, 2, 3, 4, 1/2$	
<i>Homo sapiens</i>	2 γ , 2 α , 1 δ , 1 ϵ	1 β_1 , 1 β_2 , 2 β_3 , 1 β_4
<i>Danio rerio</i>	2 γ , 1 α , 2 δ , 1 ϵ^*	1 β_1 , 2 β_2^* , 1 β_3^* , 1 β_4
<i>Drosophila melanogaster</i>	1 γ , 1 α , 1 δ	1 $\beta_1/2$, 1 β_3
<i>Caenorhabditis elegans</i>	1 γ , 1 α , 1 δ	1 $\beta_1/2$, 1 β_3
<i>Monosiga brevicollis</i>	1 γ , 1 α , 1 δ , 1 ϵ	1 $\beta_1/2$, 1 β_3 , 1 β_4
<i>Saccharomyces cerevisiae</i>	1 γ , 1 α , 1 δ	1 β_1 , 1 β_2 , 1 β_3
<i>Schizosaccharomyces pombe</i>	1 γ , 1 α , 1 δ	1 β_1 , 1 β_2 , 1 β_3
<i>Cryptococcus neoformans</i>	1 γ , 1 α , 1 δ , 1 ϵ	2 β_1 , 1 β_2 , 1 β_3
<i>Rhizopus oryzae</i>	1 γ^* , 1 α , 1 δ	1 β_1 , 1 β_2 , 1 β_3
<i>Dicystostelium discoideum</i>	1 γ , 1 α , 1 δ , 1 ϵ	1 $\beta_1/2$, 1 β_3 , 1 β_4
<i>Entamoeba histolytica</i>	2 γ^* , 3 α^* , 1 δ , 1 ϵ	3 $\beta_1/2$
<i>Trypanosoma brucei</i>	1 γ , 1 δ , 1 ϵ	1 β_1 , 1 β_3 , 1 β_4
<i>Leishmania major</i>	1 γ , 1 α , 1 δ	1 β_1 , 1 β_2 , 1 β_3
<i>Giardia intestinalis</i>	1 γ , 1 α	2 β^*
<i>Plasmodium falciparum</i>	1 γ , 1 α , 1 ϵ	1 $\beta_1/2$, 1 β_3 , 1 β_4
<i>Toxoplasma gondii</i>	1 γ , 2 α^* , 1 δ , 1 ϵ	1 $\beta_1/2$, 1 β_3 , 1 β_4
<i>Phytophthora ramorum</i>	1 γ , 1 α , 1 δ , 1 ϵ	1 $\beta_1/2$, 1 β_3 , 1 β_4
<i>Thalassiosira pseudonana</i>	1 γ , 2 α , 1 δ^* , 1 ϵ^*	1 $\beta_1/2$, 1 β_3 , 1 β_4
<i>Arabidopsis thaliana</i>	2 γ , 2 α , 1 δ , 1 ϵ	2 $\beta_1/2$, 1 β_3 , 1 β_4
<i>Oryza sativa</i>	2 γ , 1 α , 1 δ , 1 ϵ	1 $\beta_1/2$, 1 β_3 , 1 β_4
<i>Ostreococcus tauri</i>	1 γ , 1 α , 1 δ , 1 ϵ	1 $\beta_1/2^*$, 1 β_3 , 1 β_4

Table 2. Organisms names, abbreviations used in alignments, names on figures and accession numbers/database identifiers for all seq

Taxon	Abbreviation	Figure name	Accession No.
<i>Homo sapiens</i>	HsapSyn7	Homo sapiens Syn7	NP_003560
<i>Homo sapiens</i>	HsapSyn12	Homo sapiens Syn13	NP_803173
<i>Danio rerio</i>	DrerSyn7	Danio rerio Syn7	CAI29417
<i>Danio rerio</i>	DrerSyn13	Danio rerio Syn13	NP_001002051
<i>Drosophila melanogaster</i>	DmelSynE1	Drosophila melanogaster SynE1	NP_730633
<i>Drosophila melanogaster</i>	DmelSynE2	Drosophila melanogaster SynE2	NP_524054
<i>Caenorhabditis elegans</i>	CeleSynE	Caenorhabditis elegans SynE	NP_492422
<i>Monosiga brevicollis</i>	MbreEndosyn	Monosiga brevicollis SynE	26630-JGI
<i>Saccharomyces cerevisiae</i>	ScerPep12	Saccharomyces cerevisiae Pep12	NP_014679
<i>Saccharomyces cerevisiae</i>	ScerYam3	Saccharomyces cerevisiae Yam3	NP_014749
<i>Schizosaccharomyces pombe</i>	SpomVac	Schizosaccharomyces pombe Syn1	NP_595100
<i>Cryptococcus neoformans</i>	CneoSynE	Cryptococcus neoformans SynE	XP_568824
<i>Rhizopus oryzae</i>	RorySynE	Rhizopus oryzae SynE	RO3G_03490.1
<i>Dictyostelium discoideum</i>	DdissSynE1	Dictyostelium discoideum SynE1	EAL63513
<i>Dictyostelium discoideum</i>	DdissSynE2	Dictyostelium discoideum SynE2	EAL67866
<i>Dictyostelium discoideum</i>	DdissSynE3	Dictyostelium discoideum SynE3	EAL67640
<i>Entamoeba histolytica</i>	EhissSynE2	Entamoeba histolytica SynE2	EAL46030
<i>Entamoeba histolytica</i>	EhissSyn1	Entamoeba histolytica SynE1	EAL45367
<i>Trypanosoma brucei</i>	TbrusSynE1	Trypanosoma brucei SynE1	XP_826933
<i>Trypanosoma brucei</i>	TbrusSynE2	Trypanosoma brucei SynE2	XP_829689
<i>Leishmania major</i>	LmajSynE1	Leishmania major SynE1	XP_847666
<i>Leishmania major</i>	LmajSynE2	Leishmania major SynE2	CAJ07097
<i>Giardia intestinalis</i>	GintSynE	Giardia intestinalis SynE	EAA38328
<i>Plasmodium falciparum</i>	PfalSynE1	Plasmodium falciparum SynE1	NP_701466
<i>Plasmodium falciparum</i>	PfalSynE2	Plasmodium falciparum SynE2	NP_700917
<i>Phytophthora ramorum</i>	PramSynE1	Phytophthora ramorum SynE1	84649
<i>Phytophthora ramorum</i>	PramSynE2	Phytophthora ramorum SynE2	72794

<i>Phytophthora ramorum</i>	PramSynE3	Phytophthora ramorum SynE3	84062
<i>Thalassiosira pseudonana</i>	TpseSynE1	Thalassiosira pseudonana SynE1	fgenes_h1_pg_C_chr_16a000122 [Thaps3:10441]
<i>Arabidopsis thaliana</i>	AthaSyp21	Arabidopsis thaliana Syp21	NP_197185
<i>Arabidopsis thaliana</i>	AthaSyp22	Arabidopsis thaliana Syp22	NP_568671
<i>Arabidopsis thaliana</i>	AthaSyp23	Arabidopsis thaliana Syp23	NP_567537
<i>Arabidopsis thaliana</i>	AthaSynEA	Arabidopsis thaliana SynE	NP_174506
<i>Oryza sativa</i>	Osat2SynE	<i>Oryza sativa</i> SynE2	XP_467346
<i>Oryza sativa</i>	OsatSynE1	<i>Oryza sativa</i> SynE1	NP_912786
<i>Ostreococcus tauri</i>	OtauSynE1	<i>Ostreococcus tauri</i> SynE1	CAL57211-Note 1

Taxon	Abbreviation	Accession No.
<i>Homo sapiens</i>	Hsap5A	Homo sapiens Rab5A NP_004153
<i>Homo sapiens</i>	Hsap5B	Homo sapiens Rab5B NP_002859
<i>Homo sapiens</i>	Hsap5C	Homo sapiens Rab5C NP_958842
<i>Danio rerio</i>	Drer5A	<i>Danio rerio</i> Rab5A NP_958893
<i>Danio rerio</i>	Drer5B	<i>Danio rerio</i> Rab5B NP_998050
<i>Danio rerio</i>	Drer5C	<i>Danio rerio</i> Rab5C NP_958909
<i>Drosophila melanogaster</i>	Dmel5	<i>Drosophila melanogaster</i> Rab5 NP_722797
<i>Caenorhabditis elegans</i>	Cele5	<i>Caenorhabditis elegans</i> Rab5 NP_492481
<i>Monosiga brevicollis</i>	Mbre5	<i>Monosiga brevicollis</i> Rab5 34712
<i>Saccharomyces cerevisiae</i>	Scer51	<i>Saccharomyces cerevisiae</i> Ypt51 NP_014732
<i>Saccharomyces cerevisiae</i>	Scer52	<i>Saccharomyces cerevisiae</i> Ypt52 NP_012939
<i>Saccharomyces cerevisiae</i>	Scer53	<i>Saccharomyces cerevisiae</i> Ypt53 NP_014306
<i>Schizosaccharomyces pombe</i>	Spom5	<i>Schizosaccharomyces pombe</i> Rab:NP_593907
<i>Cryptococcus neoformans</i>	Cneo5A	<i>Cryptococcus neoformans</i> Rab5A XP_568296
<i>Cryptococcus neoformans</i>	Cneo5B	<i>Cryptococcus neoformans</i> Rab5B XP_567373
<i>Rhizopus oryzae</i>	Rory5a	<i>Rhizopus oryzae</i> Rab5a RO3G_11836.1
<i>Rhizopus oryzae</i>	Rory5b	<i>Rhizopus oryzae</i> Rab5b RO3G_08555.1
<i>Rhizopus oryzae</i>	Rory5c	<i>Rhizopus oryzae</i> Rab5c RO3G_08452.1

<i>Rhizopus oryzae</i>	Rory5d	Rhizopus oryzae Rab5d	RO3G_00179.1
<i>Rhizopus oryzae</i>	Rory5e	Rhizopus oryzae Rab5e	RO3G_14664.1
<i>Rhizopus oryzae</i>	Rory5f	Rhizopus oryzae Rab5f	RO3G_14437
<i>Rhizopus oryzae</i>	Rory5g	Rhizopus oryzae Rab5g	RO3G_13349.1
<i>Dictyostelium discoideum</i>	Ddis5A	Dictyostelium discoideum Rab5A	EAL71426
<i>Dictyostelium discoideum</i>	Ddis5B	Dictyostelium discoideum Rab5B	EAL66003
<i>Entamoeba histolytica</i>	Ehis51	Entamoeba histolytica Rab5.1	EAL49990
<i>Entamoeba histolytica</i>	Ehis52	Entamoeba histolytica Rab5.2	EAL46412
<i>Entamoeba histolytica</i>	Ehis53	Entamoeba histolytica Rab5.3	EAL47316
<i>Entamoeba histolytica</i>	Ehis54	Entamoeba histolytica Rab5.4	EAL44039
<i>Entamoeba histolytica</i>	Ehis55	Entamoeba histolytica Rab5.5	EAL46456
<i>Entamoeba histolytica</i>	Ehis56	Entamoeba histolytica Rab5.6	EAL47675
<i>Trypanosoma brucei</i>	Tbru5A	Trypanosoma brucei Rab5A	EAN78670
<i>Trypanosoma brucei</i>	Tbru5B	Trypanosoma brucei Rab5B	EAN79421
<i>Leishmania major</i>	Lmaj5A	Leishmania major Rab5A	CAJ03989
<i>Leishmania major</i>	Lmaj5B	Leishmania major Rab5B	CAJ02473
<i>Plasmodium falciparum</i>	Pfal5B	Plasmodium falciparum Rab5B	NP_705006
<i>Plasmodium falciparum</i>	Pfal5C	Plasmodium falciparum Rab 5C	NP_703270
<i>Plasmodium falciparum</i>	Pfal5A	Plasmodium falciparum Rab5A	NP_473028
<i>Toxoplasma gondii</i>	Tgon5A	Toxoplasma gondii Rab5A	57.m00006
<i>Toxoplasma gondii</i>	Tgon5B	Toxoplasma gondii Rab5B	25.m00220
<i>Toxoplasma gondii</i>	Tgon5C	Toxoplasma gondii Rab5C	38.m01897
<i>Arabidopsis thaliana</i>	AthaARA6	Arabidopsis thaliana Rab5-ARA6	NP_567008
<i>Arabidopsis thaliana</i>	Atha5A	Arabidopsis thaliana Rab5A	NP_193699
<i>Arabidopsis thaliana</i>	AthaRHA1	Arabidopsis thaliana Rab5-RHA1	NP_199326
<i>Oryza sativa</i>	Osat5A	Oryza sativa Rab5A	XP_469184
<i>Oryza sativa</i>	Osat5B	Oryza sativa Rab5B	AAAG42497
<i>Ostreococcus tauri</i>	Otau5A	Ostreococcus tauri Rab5A	CAL54991
<i>Ostreococcus tauri</i>	Otau5B	Ostreococcus tauri Rab5B	CAL55553

Taxon	Abbreviation	Figure name	Accession No.
<i>Thalassiosira pseudonana</i>	Tpse5	Thalassiosira pseudonana Rab5	261381
<i>Phytophthora ramorum</i>	PrRab5	Phytophthora ramorum Rab5	Pr71741
<i>Homo sapiens</i>	Hsap1G1	Homo sapiens AP1G1	NP_001025178
<i>Homo sapiens</i>	Hsap1G2	Homo sapiens AP1G2	NP_536806
<i>Homo sapiens</i>	Hsap2A2	Homo sapiens AP2A1	NP_036437
<i>Homo sapiens</i>	Hsap2A1	Homo sapiens AP2A2	NP_055018
<i>Homo sapiens</i>	Hsap3D1	Homo sapiens AP3D	NP_003929
<i>Homo sapiens</i>	Hsap4E1	Homo sapiens AP4E	NP_031373
<i>Danio rerio</i>	Drer1G1	Danio rerio AP1G1	NP_955976
<i>Danio rerio</i>	Drer1G2	Danio rerio AP1G2	XP_687483
<i>Danio rerio</i>	Drer2A1	Danio rerio AP2A	XP_686432
<i>Danio rerio</i>	Drer3D1	Danio rerio AP3D1	CAK04069
<i>Danio rerio</i>	Drer3D2	Danio rerio AP3D2	XP_685921
<i>Danio rerio</i>	Drer4E1F	Danio rerio AP4E	XP_691349/XP_691417-Note 2
<i>Caenorhabditis elegans</i>	Cel1G1	Caenorhabditis elegans AP1G	NP_740937
<i>Caenorhabditis elegans</i>	Cel2A1	Caenorhabditis elegans AP2A	NP_509572
<i>Caenorhabditis elegans</i>	Cel3D1	Caenorhabditis elegans AP3D	NP_494570
<i>Drosophila melanogaster</i>	Dmel1G1	Drosophila melanogaster AP1G	NP_788891
<i>Drosophila melanogaster</i>	Dmel2A1	Drosophila melanogaster AP2A	NP_995607
<i>Drosophila melanogaster</i>	Dmel3D1	Drosophila melanogaster AP3D	NP_524785
<i>Monosiga brevicollis</i>	Mbre1G1	Monosiga brevicollis AP1G	34237
<i>Monosiga brevicollis</i>	Mbre2A	Monosiga brevicollis AP2A	17165
<i>Monosiga brevicollis</i>	Mbre3D	Monosiga brevicollis AP3D	30296
<i>Monosiga brevicollis</i>	Mbre4E	Monosiga brevicollis AP4E	33140
<i>Saccharomyces cerevisiae</i>	Scer1G1	Saccharomyces cerevisiae AP1G	NP_015354
<i>Saccharomyces cerevisiae</i>	Scer2A1	Saccharomyces cerevisiae AP2A	NP_009516
<i>Saccharomyces cerevisiae</i>	Scer3D1	Saccharomyces cerevisiae AP3D	NP_015129

<i>Schizosaccharomyces pombe</i> Spom1G1	Schizosaccharomyces pombe AP1 NP_588559
<i>Schizosaccharomyces pombe</i> Spom2A1	Schizosaccharomyces pombe AP2 NP_595595
<i>Schizosaccharomyces pombe</i> Spom3D1	Schizosaccharomyces pombe AP3 NP_594667
<i>Cryptococcus neoformans</i> Cheo1G1	Cryptococcus neoformans AP1G XP_566557
<i>Cryptococcus neoformans</i> Cheo2A1	Cryptococcus neoformans AP2A XP_571783
<i>Cryptococcus neoformans</i> Cheo3D1	Cryptococcus neoformans AP3D XP_570825
<i>Cryptococcus neoformans</i> Cheo4E1	Cryptococcus neoformans AP4E XP_571454
<i>Rhizopus oryzae</i> Rory1G1	Rhizopus oryzae AP1G RO3G_08073-Note 3
<i>Rhizopus oryzae</i> Rory2A1	Rhizopus oryzae AP2A RO3G_03041
<i>Rhizopus oryzae</i> Rory3D1	Rhizopus oryzae AP3D RO3G_07768
<i>Dictyostelium discoideum</i> Ddis1G1	Dictyostelium discoideum AP1G EAL66400
<i>Dictyostelium discoideum</i> Ddis2A1	Dictyostelium discoideum AP2A EAL70674
<i>Dictyostelium discoideum</i> Ddis3D1	Dictyostelium discoideum AP3D EAL67707
<i>Dictyostelium discoideum</i> Ddis4E1	Dictyostelium discoideum AP4E EAL67192
<i>Entamoeba histolytica</i> Ehis1G1	Entamoeba histolytica AP1G1 EAL44666-Note 4
<i>Entamoeba histolytica</i> Ehis1G2	Entamoeba histolytica AP1G2 EAL44523
<i>Entamoeba histolytica</i> Ehis2A1	Entamoeba histolytica AP2A1 EAL44204-Note 5
<i>Entamoeba histolytica</i> Ehis2A2	Entamoeba histolytica AP2A2 EAL51006
<i>Entamoeba histolytica</i> Ehis2A3	Entamoeba histolytica AP2A3 EAL48403
<i>Entamoeba histolytica</i> Ehis3D1	Entamoeba histolytica AP3D EAL49830
<i>Entamoeba histolytica</i> Ehis4E1	Entamoeba histolytica AP4E EAL50499
<i>Trypanosoma brucei</i> Tbru1G1	Trypanosoma brucei AP1G XP_844226
<i>Trypanosoma brucei</i> Tbru3D1	Trypanosoma brucei AP3D XP_845031
<i>Trypanosoma brucei</i> Tbru4E1	Trypanosoma brucei AP4E XP_845417
<i>Leishmania major</i> Lmaj1G1	Leishmania major AP1G CAJ08121
<i>Leishmania major</i> Lmaj2A1	Leishmania major AP2A CAJ06964
<i>Leishmania major</i> Lmaj3D1	Leishmania major AP3D CAJ02187
<i>Giardia intestinalis</i> Gint1G1	Giardia intestinalis AP1G EAA36927
<i>Giardia intestinalis</i> Gint2A1	Giardia intestinalis AP2A EAA41266

<i>Plasmodium falciparum</i>	Pfal1G1	Plasmodium falciparum AP1G	NP_702418
<i>Plasmodium falciparum</i>	Pfal2A1	Plasmodium falciparum AP2A	NP_703831
<i>Plasmodium falciparum</i>	Pfal4E1	Plasmodium falciparum AP4E	NP_704583
<i>Toxoplasma gondii</i>	Tgon1G1	Toxoplasma gondii AP1G	583.m05571-Note 6
<i>Toxoplasma gondii</i>	Tgon4E1	Toxoplasma gondii AP4E	49.m03401
<i>Toxoplasma gondii</i>	Tgon3D1	Toxoplasma gondii AP3D	583.m09203
<i>Phytophthora ramorum</i>	Pram1G1	Phytophthora ramorum AP1G	47796
<i>Phytophthora ramorum</i>	Pram2A1	Phytophthora ramorum AP2A	74377
<i>Phytophthora ramorum</i>	Pram3D1	Phytophthora ramorum AP3D	75113
<i>Phytophthora ramorum</i>	Pram4E1	Phytophthora ramorum AP4E	76157
<i>Thalassiosira pseudonana</i>	Tpse1G1	Thalassiosira pseudonana AP1G	269744
<i>Thalassiosira pseudonana</i>	Tpse2A1	Thalassiosira pseudonana AP2A1	263997
<i>Thalassiosira pseudonana</i>	Tpse2A2	Thalassiosira pseudonana AP2A2	263994
<i>Thalassiosira pseudonana</i>	Tpse3D1	Thalassiosira pseudonana AP3D	263963-Note 7
<i>Thalassiosira pseudonana</i>	Tpse4E1	Thalassiosira pseudonana AP4E	596-Note 8
<i>Arabidopsis thaliana</i>	Atha1G2	Arabidopsis thaliana AP1G2	NP_176215
<i>Arabidopsis thaliana</i>	Atha1G1	Arabidopsis thaliana AP1G1	NP_173802
<i>Arabidopsis thaliana</i>	Atha2A1	Arabidopsis thaliana AP2A1	NP_197669
<i>Arabidopsis thaliana</i>	Atha2A2	Arabidopsis thaliana AP2A2	NP_197670
<i>Arabidopsis thaliana</i>	Atha3D1	Arabidopsis thaliana AP3D	NP_00103115
<i>Arabidopsis thaliana</i>	Atha4E1	Arabidopsis thaliana AP4E	NP_174454
<i>Oryza sativa</i>	Osat1G1	Oryza sativa AP1G1	NP_001056918
<i>Oryza sativa</i>	Osat1G2	Oryza sativa AP1G2	NP_001048436
<i>Oryza sativa</i>	Osat2A1	Oryza sativa AP2A	NP_001048436
<i>Oryza sativa</i>	Osat3D1	Oryza sativa AP3D	ABF93610
<i>Oryza sativa</i>	Osat4E1	Oryza sativa AP4E	NP_001043177
<i>Oryza sativa</i>	Osat1G1	Oryza sativa AP1G	NP_001045192
<i>Ostreococcus tauri</i>	Otau1G1	Ostreococcus tauri AP1G	CAL51827
<i>Ostreococcus tauri</i>	Otau2A1	Ostreococcus tauri AP2A	CAL56597
<i>Ostreococcus tauri</i>	Otau3D1	Ostreococcus tauri AP3D	CAL56719

Taxon	Abbreviation	Figure name	Accession No.
<i>Ostreococcus tauri</i>	Otau4E1	Ostreococcus tauri AP4E	CAL57153
<i>Homo sapiens</i>	Hsap1B1a	Homo sapiens AP1B	NP_001118
<i>Homo sapiens</i>	Hsap2B1a	Homo sapiens AP2B	NP_001025177
<i>Homo sapiens</i>	Hsap3B1	Homo sapiens AP3B1	NP_003655
<i>Homo sapiens</i>	Hsap3B2	Homo sapiens AP3B2	NP_004635
<i>Homo sapiens</i>	Hsap4B1	Homo sapiens AP4B	NP_031373
<i>Danio rerio</i>	Drer1B1	Danio rerio AP1B	XP_686642
<i>Danio rerio</i>	Drer2B1	Danio rerio AP2B	NP_956213-Note 9
<i>Danio rerio</i>	Drer4B1	Danio rerio AP4B	NP_956632
<i>Caenorhabditis elegans</i>	Cele1B1	Caenorhabditis elegans AP1/2B	NP_001022937
<i>Caenorhabditis elegans</i>	Cele3B1	Caenorhabditis elegans AP3B	NP_492170
<i>Drosophila melanogaster</i>	Dmel12B	Drosophila melanogaster AP1/2B	NP_523415
<i>Drosophila melanogaster</i>	Dmel3B	Drosophila melanogaster AP3B	NP_525071
<i>Monosiga brevicollis</i>	Mbre12B1	Monosiga brevicollis AP1/2B	12202
<i>Monosiga brevicollis</i>	Mbre3B1	Monosiga brevicollis AP3B	17332
<i>Monosiga brevicollis</i>	Mbre4B1	Monosiga brevicollis AP4B	16817
<i>Saccharomyces cerevisiae</i>	Scer1B1	Saccharomyces cerevisiae AP1B	NP_012787
<i>Saccharomyces cerevisiae</i>	Scer2B	Saccharomyces cerevisiae AP2B	NP_012538
<i>Saccharomyces cerevisiae</i>	Scer3B	Saccharomyces cerevisiae AP3B	NP_011777
<i>Schizosaccharomyces pombe</i>	Spom12B1	Schizosaccharomyces pombe AP1	NP_595274
<i>Schizosaccharomyces pombe</i>	Spom12B2	Schizosaccharomyces pombe AP2	NP_596435
<i>Schizosaccharomyces pombe</i>	Spom3B1	Schizosaccharomyces pombe AP3	NP_593796
<i>Cryptococcus neoformans</i>	Cneo12B1	Cryptococcus neoformans AP2B	XP_569241
<i>Cryptococcus neoformans</i>	Cneo12B2	Cryptococcus neoformans AP1B1	XP_567942
<i>Cryptococcus neoformans</i>	Cneo12B3	Cryptococcus neoformans AP1B2	XP_572541
<i>Cryptococcus neoformans</i>	Cneo3B	Cryptococcus neoformans AP3B	XP_569897
<i>Rhizopus oryzae</i>	Rory1B1	Rhizopus oryzae AP1B	RO3G_10314

<i>Rhizopus oryzae</i>	Rory2B1	Rhizopus oryzae AP2B	RO3G_00473
<i>Rhizopus oryzae</i>	Rory3B1	Rhizopus oryzae AP3B	RO3G_03499
<i>Dictyostelium discoideum</i>	Ddis12B	Dictyostelium discoideum AP1/2E	EAL67870
<i>Dictyostelium discoideum</i>	Ddis3B	Dictyostelium discoideum AP3B	EAL70926
<i>Dictyostelium discoideum</i>	Ddis4B	Dictyostelium discoideum AP4B	EAL65800
<i>Entamoeba histolytica</i>	Ehis12B1	Entamoeba histolytica AP1/2B1	EAL43905
<i>Entamoeba histolytica</i>	Ehis12B2	Entamoeba histolytica AP1/2B2	EAL44262
<i>Entamoeba histolytica</i>	Ehis12B3	Entamoeba histolytica AP1/2B3	EAL46005
<i>Giardia intestinalis</i>	GintBA	Giardia intestinalis APBA	AAM27209-Note 10
<i>Giardia intestinalis</i>	GintBB	Giardia intestinalis APBB	XP_770509
<i>Trypanosoma brucei</i>	Tbru1B	Trypanosoma brucei AP1B	XP_823038
<i>Trypanosoma brucei</i>	Tbru3B	Trypanosoma brucei AP3B	EAN80017
<i>Trypanosoma brucei</i>	Tbru4B	Trypanosoma brucei AP4B	XP_823147
<i>Leishmania major</i>	Lmaj12B1	Leishmania major AP1B	CAJ09657
<i>Leishmania major</i>	Lmaj12B2	Leishmania major AP2B	CAJ02880
<i>Leishmania major</i>	Lmaj3B1	Leishmania major AP3B	CAJ09498
<i>Plasmodium falciparum</i>	Pfal12B	Plasmodium falciparum AP1/2B	NP_703622
<i>Plasmodium falciparum</i>	Pfal3B	Plasmodium falciparum AP3B	NP_703796
<i>Plasmodium falciparum</i>	Pfal4B	Plasmodium falciparum AP4B	NP_704227
<i>Toxoplasma gondii</i>	Tgon12B	Toxoplasma gondii AP1/2B	49.m00005
<i>Toxoplasma gondii</i>	Tgon3B	Toxoplasma gondii AP3B	80.m02192
<i>Toxoplasma gondii</i>	Tgon4B	Toxoplasma gondii AP4B	57.m01782
<i>Phytophthora ramorum</i>	Pram12B	Phytophthora ramorum AP1/2B	71968
<i>Phytophthora ramorum</i>	Pram3B	Phytophthora ramorum AP3B	73678
<i>Phytophthora ramorum</i>	Pram4B	Phytophthora ramorum AP4B	80017
<i>Thalassiosira pseudonana</i>	Tpse12B	Thalassiosira pseudonana AP1/2B	41687
<i>Thalassiosira pseudonana</i>	Tpse3B	Thalassiosira pseudonana AP3B	261056
<i>Thalassiosira pseudonana</i>	Tpse4B	Thalassiosira pseudonana AP4B	268650
<i>Arabidopsis thaliana</i>	Atha12B2	Arabidopsis thaliana AP1/2B2	NP_192877

<i>Arabidopsis thaliana</i>	Atha12B1	Arabidopsis thaliana AP1/2B1	NP_194077
<i>Arabidopsis thaliana</i>	Atha3B	Arabidopsis thaliana AP3B	NP_974443
<i>Arabidopsis thaliana</i>	Atha4B	Arabidopsis thaliana AP4B	NP_196710
<i>Oryza sativa</i>	Osat12B1	Oryza sativa AP1/2B	NP_001050135
<i>Oryza sativa</i>	Osat3B1	Oryza sativa AP3B	NP_001045546
<i>Oryza sativa</i>	Osat4B1	Oryza sativa AP4B	BAD61154
<i>Ostreococcus tauri</i>	Otau12B1	Ostreococcus tauri 1/2B	CAL52356-Note 11
<i>Ostreococcus tauri</i>	Otau3B	Ostreococcus tauri 3B	CAL55772
<i>Ostreococcus tauri</i>	OtauB4	Ostreococcus tauri 4B	CAL51496

Note1=predicted protein 5569 is the correct size and has the appropriate C-terminal TM helix, thus was used.

Note2=two partial orfs are next to one another on the chromosome which represent the 2 halves of the protein.

Thus this was treated as a single ORF.

Note3=two additional truncated versions identified but excluded due to extreme size divergence and preliminary state of genome

Note 4=additional subunit found but excluded due to size

Note 5=one additional subunit found but excluded due to size

Note 6=two legitimate alpha subunit genes were also found in the T. gondii genome but were annotated as being in questionable fusions.

These were in table S1, but left out of phylogenetic analysis.

Note 7=My own annotation version used

Note 8=My own annotation version used

Note 9=one additional putative 2B identified but excluded from phylogeny due to size, one putative 3b used but also truncated and not used in phylogeny

Note 10=unclear if this is a Beta 1/2 or a Beta 3 subunit based on the phylogeny

Note 11=possibly mis-translated, but retained and used in phylogeny

Fig. 6. Model of autogenous organelle evolution. (A) Different predicted phylogenetic patterns corresponding to preLCEA-established paralogues that resolve into organelle-specific clades, and postLCEA-established clades that resolve into lineage-specific clades. (B) Establishment of novel organelles by the autogenous mechanism of identity-encoding protein gene duplications producing first basic functional division and subsequent functional elaboration. Such a process could have begun with a single generic endomembranous compartment and continued to produce the diversity of endomembranous organelles, as well as potentially the nucleus and peroxisomes. (C) Phylogenetic pattern of a protein family, should a speciation event such as the big bang occur in the midst of organellogenesis. Some components should resolve into organelle-specific clades (as illustrated by W and X), and some should resolve into lineage-specific clades (as illustrated by Y and Z). This mixed pattern should also occur to different extents for different components of the machinery for the same cellular system.

Fig. 7. Phylogeny of all SynE homologues. This phylogeny includes all retrieved SynE homologues. In this and in all following phylogeny figures, the node values and the symbols are as explained in the legend for Fig. 1.

Fig. 8. Cartoon interpretation of syntaxin, endocytic Rab, and COPI/AP evolution. (A) Schematic illustration of the timing of SynE evolution compared with other syntaxin subfamilies, which previously published analyses resolved into organelle-specific clades. Note that the branching order of the syntaxin subfamilies is not known, and the resolution shown here is for illustrative purposes only. (B) Schematic illustrating the timing of Rab 5 evolution compared with Rab 7. Although both evolved as clades before the LCEA, Rab 5 continued functional divergence in several lineages. (C) Evolution of the COPI/AP vesicle coats. The coatomers evolved away from the adaptins initially, and the adaptin 4, 3, 2, and 1 complexes subsequently evolved via gene duplications, although the order of these events, particularly the order of adaptin 3 and 4 divergence, remains unclear. However, based on phylogenetics and comparative genomics, it is clear that for the small, medium, and γ large subunits, all duplications had been completed before the LCEA. The β 1/2 subunit did not undergo gene duplication preLCEA as demonstrated here

but did undergo multiple gene duplications independently in lineages subsequently to the LCEA, producing convergently similar complex association and functionality.

Fig. 9. Phylogeny of all identified Rab 5 homologues.

Fig. 10. Rab 5 phylogeny. Shown are the results of analyses of the same dataset analyzed to produce Fig. 3, but with the long branch *O. tauri* Rab 5B sequence removed. The kinetoplastid sequences remain robustly clustered, with no other intervening sequences, suggesting a kinetoplastid-specific gene duplication. The inner box marks the separate duplicates, whereas the outer box emphasises the node supporting monophyly of these clades. In this figure and SI Figure 12, values are given for all nodes with >0.80 PP and >50% bootstrap support in PhyML and RaxML analyses. Stars denote nodes supported by better >0.95 PP and >95% bootstrap support in one of those two ML methods.

Fig. 11. Phylogeny of all identified γ , α , δ , and ϵ homologues.

Fig. 12. Phylogeny of γ , α , δ , and ϵ adaptins subunits, with long-branch taxa removed. This tree shows that the four subunits resolve strongly into separate clades according to Adaptin complexes, each encompassing representatives of the five eukaryotic supergroups sampled (nodes shown in bold and marked by gray boxes). This suggests that the subunits and complexes had already evolved before the diversification of those groups. Of note, a clearly resolved ϵ subunit was found for the fungus *Cryptococcus neoformans*, in contradiction to the common wisdom that fungi lack AP4. This indicates that the AP4 complex was in the process of degenerating and had not completed this process by the common ancestor of the basidiomycetes and ascomycetes but had completed it by the emergence of the ascomycetes such as *S. cerevisiae*. The presence of AP4 subunits both here and in the β adaptins for *M. brevicolis* pinpoints the loss of AP4 to the invertebrate lineage.

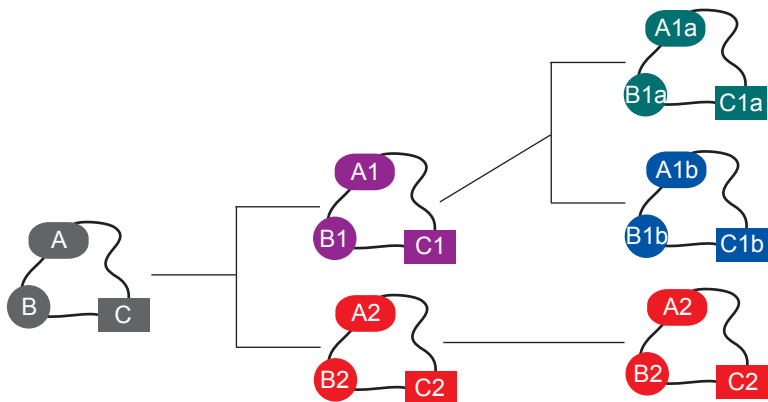
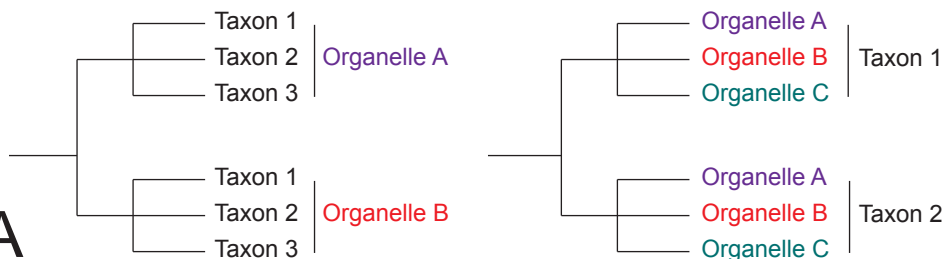
Fig. 13. Phylogeny of all identified β adaptin sequences.

Fig. 14. Phylogeny of β adaptin sequences. Tree showing that, contrary to the large γ -subunit phylogeny, and to the $\beta 3$ and B4 adaptins, the $\beta 1$ and $\beta 2$ adaptins do not form distinct clades, each encompassing eukaryotic diversity. Instead, they form a single clade with discrete $\beta 1$ and $\beta 2$ groups for vertebrates and streptophytes. The clades of $\beta 3$, $\beta 4$, and $\beta 1/2$ are marked by the gray boxes.

Organelle-specific

Lineage-specific

A

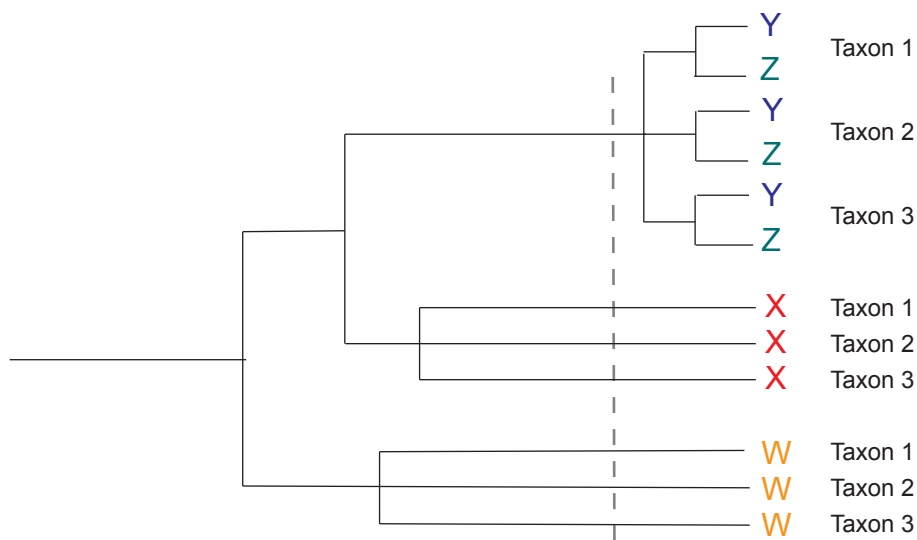


B

Generic endomembrane compartment

Basic functional division

Functional elaboration



C

Big Bang

All lineages

Lineage-specific

