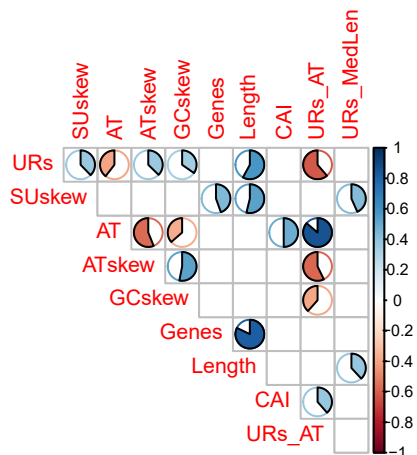


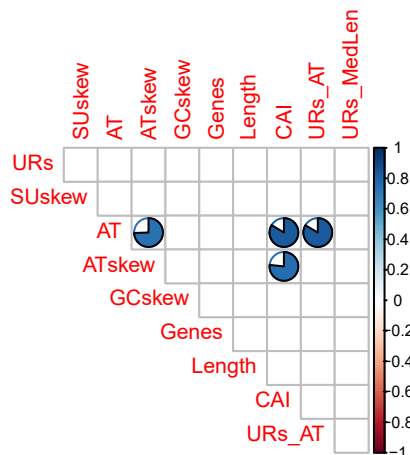
(a)

other Archaeplastida



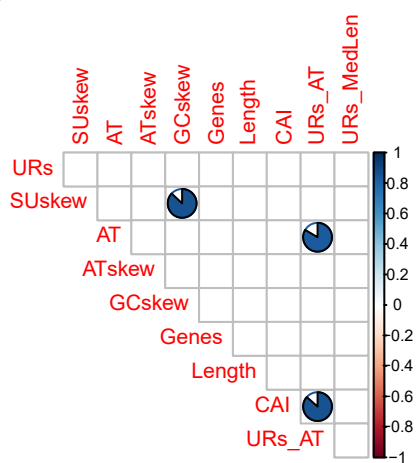
(b)

Amoebozoa

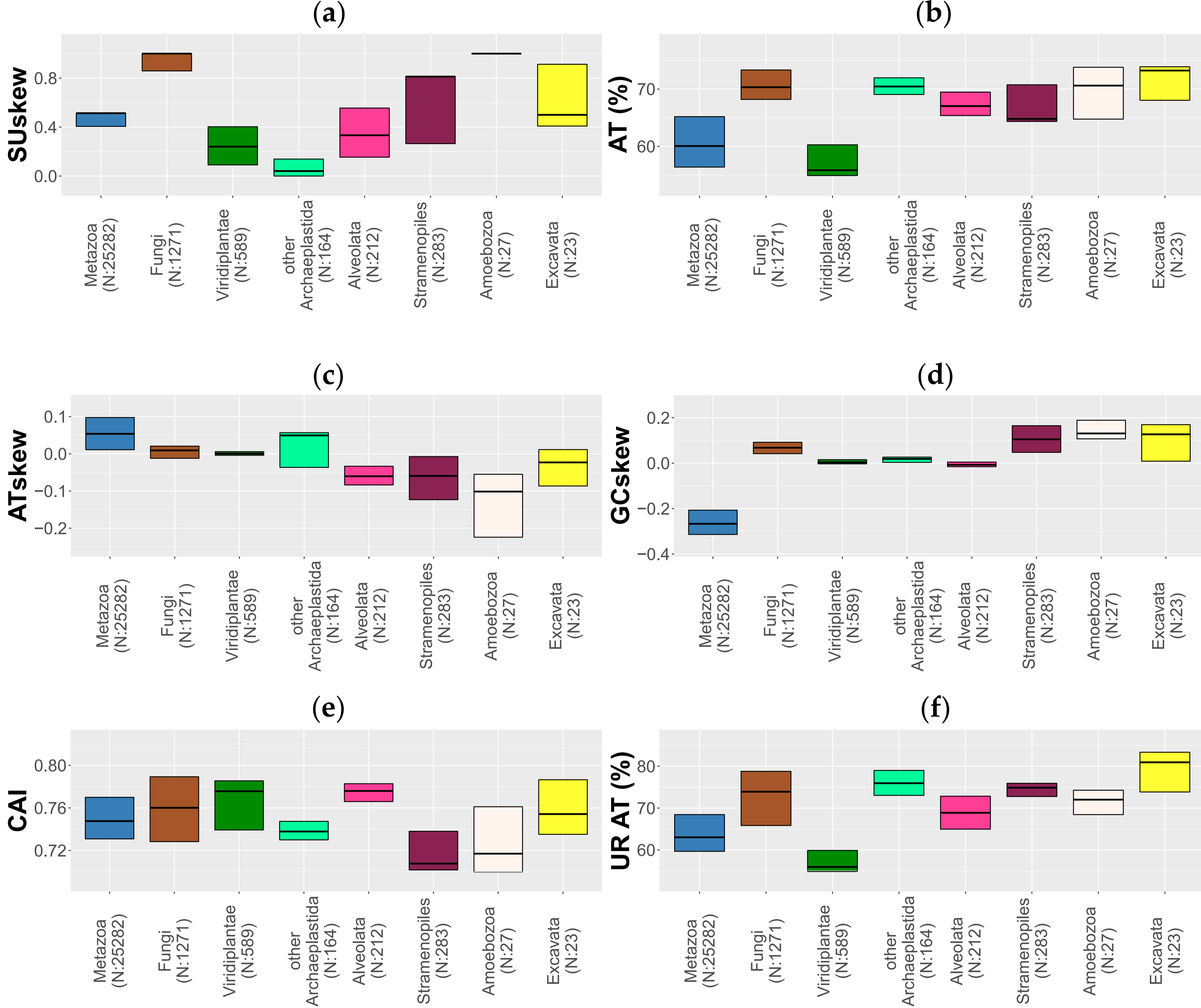


(c)

Excavata



**Supplementary Figure S1.** Correlograms for major mtDNA features. Each pie chart represents the value of a significant Spearman's rho; where the pie chart is not shown, the correlation is not significant. A blue pie shows a positive Spearman's rho, increasing clockwise from 0 to 1; a red pie shows a negative Spearman's rho, increasing counterclockwise from 0 to 1. (a) Archaeplastida excluding Viridiplantae; (b) Amoebozoa; (c) Excavata.



**Supplementary Figure S2.** Nucleotide composition and strand asymmetry. The thick line depicts the median value; the boxplot ranges from the first to the third quartile. (a) SU-skew; (b) AT (%); (c) AT-skew (%); (d) GC- skew; (e) CAI; (f) UR AT (%).

**Supplementary Table S1.** Manually excluded species and relative selected GenBank Accession Numbers.

Species	Phylum	Selected ID
<i>Anopheles gambiae</i>	Arthropoda	MG753766.1
<i>Balaenoptera physalus</i>	Chordata	MT410921.1
<i>Bos taurus</i>	Chordata	MN714217.1
<i>Bubalus bubalis</i>	Chordata	KX758298.1
<i>Canis lupus</i>	Chordata	AB499825.1
<i>Chrysomya megacephala</i>	Arthropoda	MH778860.1
<i>Equus caballus</i>	Chordata	KT221835.1
<i>Fusarium asiaticum</i>	Ascomycota	MN935318.1
<i>Gallus gallus</i>	Chordata	KY039386.1
<i>Glyphis glyphis</i>	Chordata	NC_021768.2
<i>Homo sapiens</i>	Chordata	KY411469.1
<i>Homo sapiens neanderthalensis</i>	Chordata	MG025540.1
<i>Lycorma delicatula</i>	Arthropoda	MT079445.1
<i>Lynx pardinus</i>	Chordata	KX911409.1
<i>Menidia menidia</i>	Chordata	MH538842.1
<i>Mus musculus</i>	Chordata	NC_005089.1
<i>Ovis aries</i>	Chordata	MT768219.1
<i>Pan troglodytes</i>	Chordata	NC_001643.1
<i>Plasmodium falciparum</i>	Apicomplexa	KY923536.1
<i>Plasmodium vivax</i>	Apicomplexa	KY923386.1
<i>Spadella cephaloptera</i>	Chaetognatha	KP899748.1
<i>Spadella cephaloptera</i>	Chaetognatha	KP899749.1
<i>Spadella cephaloptera</i>	Chaetognatha	KP899750.1
<i>Spadella cephaloptera</i>	Chaetognatha	KP899751.1
<i>Spadella cephaloptera</i>	Chaetognatha	KP899752.1
<i>Spadella cephaloptera</i>	Chaetognatha	NC_006386.1
<i>Sus scrofa</i>	Chordata	KX982659.1

**Supplementary Table S2.** Manually edited annotations.

Species	ID	Issue	Fix
<i>Argopecten irradians</i>	KT161259	The <i>rrnL</i> gene is annotated on the whole genome, resulting in no UR	Correct the annotation to “ <b>14940 . . 16286</b> ”
<i>Bugula neritina</i>	NC_010197	A tRNA is annotated also on the whole genome, resulting in no UR	Remove the wrong annotation line
<i>Ictalurus pricei</i>	KJ496299	The <i>rrnL</i> gene is annotated on the whole genome, resulting in no UR	Correct the annotation to “ <b>1986 . . 3645</b> ”
Placozoa sp.	NC_008832	No CDS annotation in version 4	Switch to version 3
Placozoa sp.	NC_008833	No CDS annotation in version 4	Switch to version 3
Placozoa sp.	NC_008834	No CDS annotation in version 4	Switch to version 3

**Supplementary Table S3.** Annotation bias in Unionida. Genes+, number of genes annotated on the plus strand; Genes−, genes annotated on the minus strand; *coxI* strand, strand where the *coxI* gene is annotated.

Species	ID	Genes+	Genes−	<i>coxI</i> strand	AT-skew
<i>Aculamprotula tientsinensis</i>	NC_029210	27	11	−	>0
<i>Anodonta anatina</i>	KF030962	26	12	−	>0
<i>Anodonta anatina</i>	KF030963	26	12	−	>0
<i>Anodonta anatina</i>	KF030965	27	11	−	>0
<i>Anodonta anatina</i>	KF030966	27	11	−	>0
<i>Anodonta anatina</i>	KF030967	27	11	−	>0
<i>Anodonta anatina</i>	KF030968	27	11	−	>0
<i>Anodonta anatina</i>	NC_022803	27	11	−	>0
<i>Anodonta arcaeformis</i>	NC_026674	26	11	−	>0
<i>Anodonta cygnea</i>	MF781083	26	11	−	>0
<i>Anodonta cygnea</i>	NC_036488	26	11	−	>0
<i>Anodonta lucida</i>	NC_026673	26	11	−	>0
<i>Beringiana fukuharai</i>	LC592401	26	11	−	>0
<i>Beringiana fukuharai</i>	LC592402	26	11	−	>0
<i>Beringiana fukuharai</i>	LC592403	26	11	−	>0
<i>Beringiana fukuharai</i>	LC592408	26	11	−	>0
<i>Beringiana fukuharai</i>	LC592410	26	11	−	>0
<i>Cristaria plicata</i>	GU944476	26	11	−	>0
<i>Cristaria plicata</i>	KM233451	25	12	−	>0
<i>Cristaria plicata</i>	NC_012716	25	11	−	>0
<i>Cumberlandia monodonta</i>	KU873124	26	12	−	>0
<i>Cumberlandia monodonta</i>	NC_034846	28	11	−	>0
<i>Echyridella menziesii</i>	KU873122	26	12	−	>0
<i>Echyridella menziesii</i>	NC_034845	27	11	−	>0
<i>Elliptio complanata</i>	BK010477	14	8	−	>0
<i>Gibbosula crassa</i>	NC_037942	27	11	−	>0
<i>Hyriopsis cumingii</i>	HM347668	26	11	−	>0
<i>Hyriopsis cumingii</i>	KM393224	26	11	−	>0
<i>Hyriopsis cumingii</i>	LC498621	26	11	−	>0
<i>Hyriopsis cumingii</i>	NC_011763	26	11	−	>0
<i>Lamprotula coreana</i>	NC_026035	26	11	−	>0
<i>Lamprotula gottschei</i>	KJ627225	26	11	−	>0
<i>Lamprotula gottschei</i>	NC_023806	8	29	−	>0
<i>Lamprotula leaii</i>	KC847114	26	11	−	>0
<i>Lamprotula leaii</i>	NC_023346	26	11	−	>0

<i>Lamprotula tortuosa</i>	KC441487	26	11	-	>0
<i>Lamprotula tortuosa</i>	NC_021404	26	11	-	>0
<i>Lampsilis cardium</i>	BK010478	26	11	-	>0
<i>Lampsilis ornata</i>	NC_005335	26	11	-	>0
<i>Lampsilis powellii</i>	MF326972	26	12	-	>0
<i>Lampsilis powellii</i>	NC_037720	26	12	-	>0
<i>Lampsilis siliquoidea</i>	MF326974	26	12	-	>0
<i>Lampsilis siliquoidea</i>	NC_037721	26	12	-	>0
<i>Lanceolaria gladiola</i>	KY067441	26	11	-	>0
<i>Lanceolaria lanceolata</i>	KJ775864	26	11	-	>0
<i>Lanceolaria lanceolata</i>	NC_023955	26	11	-	>0
<i>Lasmigona compressa</i>	NC_015481	28	10	-	>0
<i>Leaunio lienosus</i>	BK010479	23	11	-	>0
<i>Lepidodesma languilati</i>	NC_029491	26	11	-	>0
<i>Margaritifera dahurica</i>	NC_023942	27	11	-	>0
<i>Margaritifera falcata</i>	NC_015476	28	10	-	>0
<i>Margaritifera margaritifera</i>	BK010445	26	11	-	>0
<i>Mutela dubia</i>	NC_034844	26	11	-	>0
<i>Nodularia douglasiae</i>	KP970613	26	11	-	>0
<i>Nodularia douglasiae</i>	LC496352	25	12	-	>0
<i>Nodularia douglasiae</i>	LC589171	26	11	-	>0
<i>Nodularia douglasiae</i>	LC589172	26	11	-	>0
<i>Nodularia douglasiae</i>	MF314443	25	12	-	>0
<i>Nodularia douglasiae</i>	MT764726	26	11	-	>0
<i>Nodularia douglasiae</i>	MT955592	25	12	-	>0
<i>Nodularia douglasiae</i>	NC_026111	26	11	-	>0
<i>Parvasolenia rivularis</i>	KY007142	26	11	-	>0
<i>Parvasolenia rivularis</i>	NC_039839	26	11	-	>0
<i>Potamilus alatus</i>	KU559011	29	9	-	>0
<i>Potamilus alatus</i>	NC_033858	27	11	-	>0
<i>Potamilus leptodon</i>	NC_028522	26	11	-	>0
<i>Potamilus streckersoni</i>	MW413895	27	11	-	>0
<i>Pronodularia japonensis</i>	LC505454	26	11	-	>0
<i>Ptychorhynchus pfisteri</i>	KY067440	26	11	-	>0
<i>Pyganodon grandis</i>	FJ809755	26	11	-	>0
<i>Pyganodon grandis</i>	NC_013661	26	11	-	>0
<i>Quadrula quadrula</i>	FJ809751	26	11	-	>0
<i>Quadrula quadrula</i>	NC_013658	26	11	-	>0
<i>Sinanodonta tumens</i>	LC592406	26	11	-	>0
<i>Sinanodonta woodiana</i>	HQ283344	27	11	-	>0

<i>Sinanodonta woodiana</i>	HQ283345	27	11	-	>0
<i>Sinanodonta woodiana</i>	HQ283346	27	11	-	>0
<i>Sinanodonta woodiana</i>	HQ283347	27	11	-	>0
<i>Sinanodonta woodiana</i>	HQ283348	27	11	-	>0
<i>Sinanodonta woodiana</i>	MH349356	26	14	-	>0
<i>Sinanodonta woodiana</i>	MH349359	26	14	NA	>0
<i>Sinanodonta woodiana</i>	NC_024943	27	11	-	>0
<i>Sinohyriopsis schlegelii</i>	AP018550	26	11	-	>0
<i>Sinohyriopsis schlegelii</i>	AP018551	26	11	-	>0
<i>Sinohyriopsis schlegelii</i>	HQ641407	26	11	-	>0
<i>Sinohyriopsis schlegelii</i>	LC498622	26	11	-	>0
<i>Sinohyriopsis schlegelii</i>	NC_015110	26	11	-	>0
<i>Solenaiia carinata</i>	KC848655	26	12	-	>0
<i>Solenaiia carinata</i>	NC_023250	27	11	-	>0
<i>Solenaiia oleivora</i>	KY007143	26	11	-	>0
<i>Solenaiia oleivora</i>	MT477834	27	10	-	>0
<i>Solenaiia oleivora</i>	NC_022701	26	11	-	>0
<i>Toxolasma parvum</i>	NC_015483	27	11	-	>0
<i>Unio crassus</i>	KY290447	26	12	NA	>0
<i>Unio crassus</i>	KY290448	26	12	NA	>0
<i>Unio crassus</i>	KY290449	26	12	NA	>0
<i>Unio crassus</i>	KY290450	26	12	NA	>0
<i>Unio crassus</i>	NC_033976	26	12	NA	>0
<i>Unio delphinus</i>	KT326918	26	12	-	>0
<i>Unio delphinus</i>	NC_033854	27	11	-	>0
<i>Unio pictorum</i>	HM014131	26	11	-	>0
<i>Unio pictorum</i>	HM014132	26	11	-	>0
<i>Unio pictorum</i>	HM014133	26	11	-	>0
<i>Unio pictorum</i>	HM014134	26	11	-	>0
<i>Unio pictorum</i>	MH349357	26	12	NA	>0
<i>Unio pictorum</i>	MH349358	26	12	NA	>0
<i>Unio pictorum</i>	NC_015310	26	11	-	>0
<i>Unio tumidus</i>	KY021074	26	12	-	>0
<i>Unio tumidus</i>	KY021075	26	12	-	>0
<i>Unio tumidus</i>	KY021076	27	11	-	>0
<i>Unio tumidus</i>	KY021077	27	11	-	>0
<i>Unio tumidus</i>	KY021078	27	11	-	>0
<i>Unio tumidus</i>	NC_033977	26	12	-	>0
<i>Uniomereus tetralasmus</i>	BK010480	23	10	-	>0
<i>Utterbackia imbecillis</i>	NC_015479	27	11	-	>0

<i>Utterbackia peninsularis</i>	HM856636	28	10	-	>0
<i>Utterbackia peninsularis</i>	NC_015477	26	12	-	>0
<i>Venustaconcha ellipsiformis</i>	FJ809753	26	11	-	>0
<i>Venustaconcha ellipsiformis</i>	NC_013659	27	10	-	>0
<i>Aculamprotula scripta</i>	NC_045529	11	26	+	<0
<i>Acuticosta chinensis</i>	MF687347	11	27	+	<0
<i>Acuticosta chinensis</i>	NC_042472	11	26	+	<0
<i>Alasmidonta heterodon</i>	NC_037431	11	27	+	<0
<i>Alasmidonta varicosa</i>	NC_038155	11	27	+	<0
<i>Amblema plicata</i>	NC_050056	11	26	+	<0
<i>Anemina euscaphys</i>	NC_026792	11	26	+	<0
<i>Anodonta anatina</i>	MN594531	11	26	+	<0
<i>Anodonta cygnea</i>	MN594532	11	26	+	<0
<i>Anodonta exulcerata</i>	MN594533	11	26	+	<0
<i>Anodonta nuttalliana</i>	MN594534	11	26	+	<0
<i>Chamberlainia hainesiana</i>	MK994771	11	26	+	<0
<i>Chamberlainia hainesiana</i>	NC_044110	11	26	+	<0
<i>Cuneopsis capitata</i>	NC_042469	11	26	+	<0
<i>Cuneopsis heudei</i>	MF687348	11	27	+	<0
<i>Cuneopsis heudei</i>	NC_042471	11	26	+	<0
<i>Cuneopsis pisciculus</i>	NC_026306	11	26	+	<0
<i>Lamprotula caveata</i>	KX091842	11	26	+	<0
<i>Lamprotula caveata</i>	NC_030336	12	25	+	<0
<i>Lamprotula scripta</i>	NC_030258	13	25	+	<0
<i>Lanceolaria grayii</i>	NC_026686	13	24	+	<0
<i>Margaritifera margaritifera</i>	MK421957	11	26	+	<0
<i>Margaritifera margaritifera</i>	MK421958	11	26	+	<0
<i>Margaritifera margaritifera</i>	MK421959	11	26	+	<0
<i>Margaritifera margaritifera</i>	NC_043836	11	26	+	<0
<i>Microcondylaea bonellii</i>	MK994773	11	26	+	<0
<i>Microcondylaea bonellii</i>	NC_044111	11	26	+	<0
<i>Monodontina vondembuschiana</i>	NC_044112	11	26	+	<0
<i>Pilsbryconcha exilis</i>	MK994777	11	26	+	<0
<i>Pilsbryconcha exilis</i>	NC_044124	11	26	+	<0
<i>Pleurobema oviforme</i>	NC_050057	11	26	+	<0
<i>Popenaias popeii</i>	NC_050058	11	26	+	<0
<i>Potomida littoralis</i>	KT247375	11	26	+	<0
<i>Potomida littoralis</i>	NC_030073	11	26	+	<0
<i>Pseudanodonta complanata</i>	MN594535	11	26	+	<0
<i>Pseudunio maroccanus</i>	KY131954	11	26	+	<0



<i>Pseudunio maroccanus</i>	NC_034911	11	26	+	<0
<i>Schistodesmus lampreyanus</i>	NC_042470	11	26	+	<0
<i>Sinanodonta woodiana</i>	KM434235	11	26	+	<0
<i>Sinanodonta woodiana</i>	MN594536	11	26	+	<0
<i>Unio elongatulus</i>	MN594537	11	26	+	<0
<i>Unio mancus</i>	MN594538	11	26	+	<0

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