# Compilation of tRNA sequences and sequences of tRNA genes

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# ABSTRACT

Sequences of 3279 sequences of tRNA genes and tRNAs published up to December 1996 are included in the compilation. Alignment of the sequences, which is most compatible with the tRNA phylogeny and known threedimensional structures of tRNA, is used. Sequences and references are available under http://www.uni-bayreuth.de/departments/biochemie/trna/

# INTRODUCTION

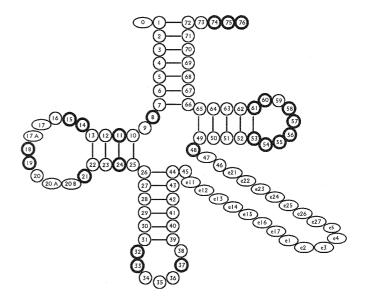
The 1997 compilation contains 3279 sequences of tRNAs and tRNA genes. The last edition which appeared two years ago (1) was supplemented by 579 new sequences covering the literature up to December 1995. The sequences of tRNA mutants and of tRNAs originating from transformed or differentiated cells were not considered.

The tRNAs included in the compilation are listed in Table 1. Each tRNA or tRNA gene is specified by the (abbreviated) name of the organism from which it was isolated and a four digit code: the first three digits identify the organism, the last digit specifies the particular isoacceptor. The amino acid specificity of the tRNA is indicated by a one-letter amino acid code. The tRNAs coding for selenocysteine were annotated with the letter Z. Initiator tRNAs are annotated with the letter X.

The references are restricted to the first publication of the complete sequence unless additional information (e.g., base modification, corrections, etc.) was later obtained. In such cases additional references were added.

In order to facilitate a computer analysis an alignment is used which is most compatible with the tRNA phylogeny and known three-dimensional structures of tRNA. The corresponding numbering system is shown in Figure 1.

As was the case in the previous edition (1), this publication does not contain a sequence printout. Instead, the sequences, references and footnotes of tRNAs and tRNA genes listed in Table 1 are deposited in the European Bioinformatics Institute (EBI) Data Library. In addition, a World Wide Web page has been established and is available under http://www.uni-bayreuth.de/departments/ biochemie/trna/. The present publication should be quoted as a reference for the electronically accessible data.



**Figure 1.** Numbering of nucleotides in tRNAs. Circles represent nucleotides which are always present; the ovals, nucleotides which are not present in each structure: these are nucleotides before the position 1 on the 5'-end, before and after the two invariant GMP residues 18 and 19 in the D-loop, and the nucleotides in the variable loop. The nucleotide to be added at a given site is indicated by the number of the preceeding nucleotide followed by a colon and a letter in alphabetical order. The nucleotides in the variable stem have the prefix 'e' and are located between position 45 and 46 obeying the base-pairing rules. The nucleotides in the 5'-strand and the 3'-strand are numbered by e11, e12, e13, ... and e21, e22, e23, ..., respectively; the second digit identifies the base-pair. In the case of a long variable region, the loop can be formed by up to 5 nt: e1, e2, e3, e4 and e5. Positions, in which invariant nucleotides usually occur are indicated by a thick line.

Researchers who wish to perform an advanced search for tRNA sequences according to several criteria, e.g., anticodon, amino acid specificity, modified nucleoside, or wish to print the requested sequence in the form of Table 2 or cloverleaf format (Fig. 1) can obtain appropriate software on diskette. Please contact M. Sprinzl, Laboratorium für Biochemie, Universität Bayreuth, D-95440 Bayreuth, Germany, Fax: +49 921 552432, Email: Mathias.Sprinzl@uni-bayreuth.de.

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Table 1. List of tRNA sequences and sequences of tRNA genes included in the compilation

PART ONE: Sequences of tRN	A genes		PSEUDOMONAS FLUOR. CAMPYLOBAC.JEJUNI	184 186	AI AI
Source	Code	tRNA genes	RICKETTSIA PROW. CAULOBACTER CRES.	187 189	GWY AI
/IRUSES	000-02		BRUCELLA SUIS	190	AI
IKOBEB	000-02:	y	BRUCELLA MELLITENS. BRUCELLA ABORTUS	191 192	AI AAII
IYCOBACTERIOPH. L5	020	NQW	AZORHIZOBIUM CAUL:	193	G
HAGE PHI C31	031	CH DOD CT	RHIZOBIUM MELILOTI.	194	L
HAGE T4 HAGE T5	022 026	GILPQRST ACDEFGHIKLMNPQSSTVWXY	AZOARCUS SP.BH72 OCHROBACTRUM ANTH.	195 196	
			BORDETELLA PERTUS.	198	AI L
RCHAEBACTERIA	030-10		HAEMOPHILUS INFLU.	200	AAAACDDDEFGGGHIIIKKKKLLLLLMMM NNPQQRRRRSSSSTTVVWY
RCHAEGLOBUS FULG. ALOBACTERIUM CUT.	034 038	A	ANACYSTIS NIDULANS	210	AI
ALOBACTERIUM HAL.	038	AC A	SYNECHOCYSTIS SP.	214	AACDFGGGIIIHKKLLLLLNPPP QRRRRSSSSTTTVVWWXXY
ALOBACTERIUM MAR.	044	LS	SYNECHOCOCCUS SP.	215	L
ALOBACTERIUM MED.	046	W	CYANOPHORA PARAD.	218	AEGHILRS
ALOFERAX VOLCANII	050	CW	PYLAIELLA LITTORA.	222	AI
ETHANOBAC.FORMI. ETHANOBAC.THERM.	058 062	A	STREPTOCOCCUS PN.	224	A
ETHANOGAC. THERM.	065	Α	STREPTOCOCCUS SAL.	225	A
AACDEFGGF		MNQPPRRRSSSTTVVVWXY	ORGANELLES		
ETHANOCOC.VANI.	066	ADEFHIKLNPQRTTVY	***************************************		
ETHANOTHRIX SOEH.	067	A ADELIIZI MAIDET	CHLOROPLASTS	240-35	59
IETHANOTHERM. FER. UMINOBACTER AMYLO	068 070	ADEHIKLMNPST E		2,40	AT
ETHANOCOC.VOLTAE	074	DKPTY	CYANOPHORA PARAD. PYLAIELLA LITTORA.	240 241	AI AI
ETHANOPYRUS KAND.	076	KLQS	CHLAMYDOMONAS REIN	241	ACDEGIMRRTW
IETHANOSPIR. HUNG.	078	A	CHLAMYDOMO. MOEWU.	246	T
ULFOLOBUS SOLFA.	086	FGLSVX	CHLORELLA ELLIPSO.	248	AIRS
HERMOPLASMA ACID.	090 094	M	LYCOPERSICON ESCU.	249	DLY
HERMOCOCCUS CELER HERMOFIL. PENDENS	094	APT GM	CUCUMIS SATIVUS	250	E
HERMOPROT. TENAX	098	AALLX	ASTASIA LONGA EUGLENA GRACILIS	251 252	ACDGIKLMPQRSSTV
			CRYPTOMONAS SPEC.	252	AACDEFGGHIIKLLLMNPQRRSSTVWXXY AIR
UBACTERIA	110-239		SPIROGYRA MAXIMA	255	I
			ANTITHAMNION SP.	257	AI
ARTONELLA BACIL.	110		CYANIDIUM CALDAR.	258	AIK
ARTONELLA ELIZAB. ARTONELLA HENSELA.	111 112	AI I	OLISTHODISCUS LUT.	259	AI
ARTONELLA QUINT.	112	AI	MARCHANTIA POLYM. CUSCUTA REFLEXA	260 261	ACDEFGGHIIKLLLMNPPQRRRSSSTTVVWXY AHILMV
IYCOPLASMA CAPRIC.	114	ACDEFGHIIKKLLMNPQRRSSTTVWWXY	COLEOCHAETE ORBIC.	262	AI
IYCOPLASMA GEN.	115	ACDEFGGHIIKKLLMMNPQRRSSSSTTTWWY	HORDEUM VULGARE	264	GGMSTVX
IYCOPLASMA MYCOID.	118	ADEFGIMNPRRSTVX	TRITICUM AESTIVUM	268	CDEGGMPRSTWXY
IYCOPLASMA PNEU. IYCOPLASMA PG50	120 122	ACDEEGGHIIKKLLMNPQRRRSSSSTTTVWWXYY KL	ORYZA SATIVA	270	ACCDEFGGHIILLLMMNPQRRSSSTTVVWY
CHOLEPLASMA LAID.	123	AACDEFGHIIKKLLLMMNQRSSTVW	ZEA MAYS	272	AACDEFGGHHIIKLLLLMN PQRRSSSSSTTTVVVWXXY
PIROPLASMA CITRI.	125	SWW	EPIFAGUS VIRGINIA.	274	LNR
PIROPLASMA MELIF.	126	ACDFIMPRSX	ARABIDOPSIS THAL.	276	IMP
ORRELIA BURGDORF.	128	AI	ALLIUM PORRUM	278	R
IREPTOMYCES GRIS. IREPTOMYCES COEL.	130 131	S L	BRASSICA OLERACEA	280	
TREPTOMYCES RIM.	134	EQQXX	GLYCINE MAX MEDICAGO SATIVA	284 288	AIMV H
TREPTOMYCES LIV.	135	CDEEEGGKNNQQRSVVY	NICOTIANA TABACUM	292	ACDEFGGHIIKLLLMNPQRRSSSTTVVWXY
TREPTOMYCES AMBO.	136	P	NICOTIANA DEBNEYI	296	Н
HLOSTRIDIUM PERFR.	139	S	OENOTHERA SP.	300	PW
YCOBACT. TUBERC. LEBSIELLA AEROGE.	140 141	PV N	DAUCUS CAROTA	301	V
GROBACTER. TUME.	141	R	GOSSYPIUM HIRSUTUM PELARGONIUM ZONALE	302 304	H . R
LOSTRIDIUM THERM.	143	Z	PENNISETUM AMERICA	304	R I
ESULFOMICR. BACU.	144	Z	PETUNIA HYBRIDA	312	Ĥ
LOSTRIDIUM ACETO.	145	T	PHASEOLUS VULGARIS	316	Н
LESIOMONAS SHIGE. NTEROCOCCUS HIRAE	146 147	E	HELIANTHUS ANNUUS	317	HNY
TAPHYLOCOC. AURE.	147	A ACDDFGGGGHIKLLLMPQRSSTTVVWXY	PISUM SATIVUM PINUS THUNBERGII	320 322	DEGHKLNPRRSTVWXY
ACTOBAC. BULG.	150	DEGNPRSV	PINUS CONTORTA	322	ACDEFGGHIIKLLLMNPPQRRRSSSTTVVWXY HK
ACTOBAC.DELBRUEC.	152	S	SINAPIS ALBA	324	HKQSV
ACTOCOCCUS LACTIS	153	AAAEFGINSX	SPINACIA OLERACEA	328	ACDEHIILMRSSTTVY
ACILLUS SUBTILIS	154	AAAACDEFFGGGHHIIIKKLLLLLMMNNPQ	SPIRODELA OLIGORH.	332	NRR
ACILLUS CIRCULANS	156	RSSSTTTVWXXY P	VICIA FABA	336	EFHLLTY
ACILLUS SP. PS3	150	DENSV	SORGHUM BICOLOR	340	L
HERMUS THERMOPHI.	158	GGITY	MITOCHONDRIA	360-59	9
IERMOTOGA MARIT.	159	MMTWY			-
HODOTHERMUS MAR.	160	AI	SINGLE CELL ORGANISMS	360-41	9
HOBACILLUS FERRO	162	AI	AND FUNGI		
TGMATELLA AURANT. COLI	163 166	GTTY A A CDFEGGGHIIKI I I I I MNDDDOODDDDD	DB OTOTUECA DACATE	200	
0051	100	AACDEFGGGHIIKLLLLLMNPPPQQRRRRR SSSSTTTTTVVVWXXYYZ	PROTOTHECA WICKER. PYLAIELLA LITTOR.	360 361	ACDEFGGHIIKLLMNPQRRSSTVWXY KPY
ALMONELLA TYPHI.	170	HLPRR	CHONDRUS CRISPUS	362	ACEGGHIKLLMNPORRSVWXY
ZOSPIRILLUM LIPO.	172	KTV	PLATYMONAS SUBCORD.	363	KNPVY
RICHODESMIUM SPEC	173	AI	CHLAMYDOMO. REINH.	364	MQW
HOTOBACT. PHOSPH.	174	HP	ODONTELLA SINENSIS	365	AACDEFGGHIIIKLLNPPQRRSSTVWXY
HOTOBAC. LEIOGNA.	175	LM AEHILPR	PLASMODIUM FALCIP. TRYPANOSOMA BRUCEI	366 368	CDEGGHKLPQSSWXY
EROMONAS HYDROPH.	178				AA

Table 1. continued

CAENORHABDLELEG.468ACDEFGHIKLLNPQRSSTVWYYSINGLE CELL ORGANISMS600-6ARTEMIA SP.472EFSAND FUNGILOCUSTA MIGRATORIA476ACDDEFGGHIKKLLNPPQRSSTVWYYPLASMODIUM FALSI.603METRIDIUM SENLLE477LPLASMODIUM FALSI.603METRIDIUM SENLLE478XTRYPANOSOMA BRUCEI605NEPHILA CLAVIPES479AAAATETRAHYMENA PYRIF.606ADDE SALBOPICTUS480AEFGLNRSVLEISHMANIA TARENT.609LOLIGO BLEEKERI481KKKKKDICTYOSTELIUM DIS.616APIS MELLFERA482ACDDEFGHIKLLMPQRSSTVWYPHYSARUM POLYCEPH.618DAROSOPHILA VAKUBA483IQVWXYNEUROSPORA CRASSA620DROSOPHILA VAKUBA484ACDEFGHIKLLNPQRSSTVWXYPHYTOPHTHORA PAR.622DROSOPHILA VIRLIS496IQXPODOSPORA ANSERINA624CHORISTONBURA FUM.497LSACCHAROMYCES CER.632PROTOPTERUS DOLLOI498ACDEFGHIKLLNPQRSSTVWXYCANDIDA CYLINDRA.637CERATITIS CAPITATA501ACDEFGHIKLLNPQRSSTVWXYCHLAMYDIA TRACHOM.670-7CYPRINUS CARPIO503ACDEFGHIKLLNPQRSSTVWXYRABIDOPIST THAL.670-7CYPRINUS CARPIO503ACDEFGHIKLLNPQRSSTVWXYRABIDORIST THAL.670ANDEFRES504ACDEFGHIKLLNPQRSSTVWXYRABIDOPIST THAL.670-7CPRINUS CARPIO503ACDEFGHIKLLNPQRSSTVWXYRABIDORIST THAL.670-7CRENTRATIS CAPITA					
PARAMECUM TETRA.         796         VY         PIALAMECUM TETRA.         796         VY           PARAMECUM ATERIA.         796         VILVIX         CENTIONPRIMENT, 311           PARAMECUM ATERIA.         796         VILVIX         CENTIONPRIMENT, 311           PERALISSIND.L.         886         ACCIDERCHILLIMANPORTSTVWAY         EALAPOPTER A PURC.         331           ASPERICULUS MARA.         887         ACCIDERCHILLIMANPORTSTVWAY         EALAPOPTER A PURC.         332           POLOSTRIA CRAVELICS.         897         ACCIDERCHILLIMANPORTSTVWAY         EALAPOPTER A PURC.         332           POLOSTRIA CRAVELICS.         897         ACCIDERCHILLIMANPORTSTVWAYY         GLAVED MARAMER.         384           POLOSTRIA CRAVELICS.         897         ACCIDERCHILLIMANPORTSTVWAYY         GLAVED MARAMER.         384           PUELA PURCH         402         LMM         ELIPOCERCOLOSCON.         441           PUELA PURCH         402         LMM         ELIPOCERCOLOSCON.         441           PUELA PURCH         402         LMM         ELIPOCERCOLOSCON.         441           PUELA PURCH         402         CERTRIALRERETWAY         MAACACARAELANINES         356           PUELA PURCH         403         MARAMARAELANINES         456         <	PARAMECIUM PRIM.	372	XY	METACHIRUS SP	529
TETERATIVES         MODE         MODE         MODE         MODE           MERASTIVAS CHERAL         MARCOSTANDA         SI         MACOSTANDA         SI           MERASTIVAS CHERAL         MACOSTANDA         SI         MACOSTANDA         SI           MERASTIVAS CHERAL         MACOSTANDA         SI         MACOSTANDA         SI           MERASTIVAS CHERAS         SI         ACAR         BULLETORING NY NE         SI           MERASTIVAS CHERAS         SI         ACAR         BULLETORING NY NE         SI           MERASTIVAS CHERASTIVA         BULLETORING NY NE         BULLETORING NY NE         SI           SACCHARONYCES EXL         40         ME         BULDORING NY NE         SI           MULDINGKO MARANEL         40         CEPGRIKINFRAUVY         MACACA ASSAMENSES         SI           VILLUTYSKONTERS LAC         40         CEPGRIKINFRAUVY         MACACA ASSAMENSES         SI           VILLUTYSKONTERS SULAT         40         MACACA ASSAMENSES         SI         SI           VILLUTYSKONTERS SULAT         40         MACACA ASSAMENSES         SI         SI           MACACA ASSAMENSES         40         MACACA ASSAMENSES         SI         SI           MULLUTYSKONTERS SULAT         40 <td< td=""><td>PARAMECIUM TETRA.</td><td>376</td><td>WY</td><td></td><td></td></td<>	PARAMECIUM TETRA.	376	WY		
TETE-ATMUSIANTEREM.         394         LXT         CERVIS.NUPPON         331           ARERACLISS NAL.         386         MARTY GREELLAANPQUESTVWYY         BALANDOFTER.A. NURL.         384           ARESOLUSS NAL.         387         ACADR.         MARTY GREELLAANPQUESTVWYY         BALANDOFTER.A. NURL.         384           DOCSPERA. CLRASEN.         395         ACADR.         MARTY GREEN.         381           POCHSPERA. CLRASEN.         395         NORSPUEST         GLASEN.         384           POCHSPERA. CLRASEN.         397         NORSPUEST.         GLASEN.         384           ACADR.         MARTY GREEN.         MARTY GREEN.         MARTY GREEN.         384           ACADR.         MARTY GREEN.         MARTY GREEN.         MARTY GREEN.         384           ACADR.         MARTY GREEN.         MARTY GREEN.         MARTY GREEN.         384           MARTY GREEN.         400         MARTY GREEN.         MARTY GREEN.         384				CNEDIMOPHORUS UNI.	531
ASERGLUUS PUML 387 ERMATY BALARNOPTIC PHYS. 594 ASERGLUUS PUML 387 ACCERFORMULLIAMANPRESTYVWYY BALARNOPTIC PHYS. 594 PODOSPECA ANSERVA. 595 DONSYW BEALARNOPTIC PHYS. 594 PHOLA VITLANA 318 PHOLA V					
ASPERCIUS NUCL         SBS         ACCENT CONTRACT         PLAND FOR ALL MARCE         Dist           MERROSPICA CREASE         SP         Dist NVW         PLAND FOR ALL MARCE         SP           MERROSPICA CREASE         SP         Dist NVW         PLAND FOR ALL MARCE         SP           MERROSPICA CREASE         ACCENT ALL MARCE         ACCENT ALL MARCE         SP         SP           ACCENT ALL MARCE         ACCENT ALL MARCE         ACCENT ALL MARCE         SP         SP           SACCIALAD MARCE         ACCENT ALL MARCE         SP         SP         SP         SP           SACCIALAD MARCE         ACCENT ALL MARCE         SP					
NEERGEPERACEASSA         29         ACMR         DOWNE         DS           PACEMARPHA         29         DARNAVW         FILACEDERUS CRYPUS         DS           PACEMARCHARPA         29         NACCOSCILLATIONAL         DARNAVW         FILACEDERUS CRYPUS         DS           PACEMARCHARPACENERIAL         20         NACCOSCILLATIONAL         DARNAVW         FILACEDERUS CRYPUS         DS           PACEMARCHARPHERINA         20         NACCOSCILLATIONAL         DR         DR         DR           PACEMARCHARPHERINA         20         NACMARCHARPHERINAL         REILOPERUS CRYPUS         SS           PACEMARCHARPHERINA         20         CRADIA         DR         DRACACAASSANENESS         SS           ALANDRIA         40         ACCORFORMICLAMMARCHARPHERINAL         MACACAASTANANANA         SS         SAMANG         SS           ALANDRIA         40         MACACAASTANANANANANANANANANANANANANANANANANAN					
DDDSDREA ANSREINA         SHE         DANSYW         FALLEGEBRES GRYUES         ST           PODSREGA ASSREINA         SACELARAMYCS CEL         AD. DEPGHIELLANPERASTIV/WXYY         GAUDS MORELA         SS           SACELARAMYCH SCHL         40         AD. DEPGHIELLANPERASTIV/WXYY         GAUDS MORELA         SS           SACELARAMYCH SCHL         40         AD. DEPGHIELLANPERASTIV/WXYY         GAUDS MORELA         SS           SACELARAMYCH SCHL         40         AD. DEPGHIELLANPERTYWY         MACACA STELENTS         SS           CANDAR ARAMESTED         40         CEEPGHIELLANPERTYWY         MACACA STELENTS         SS           CANDAR ARAMESTED         40         AD. CEEPGHIELLANPERTYWY         MACACA STELENTS         SS           CANDAR ARAMESTED         40         M         MACACA STELENTS         SS           CANDAR ARAMESTED         40         M         MACACA STELENTS         SS           FILLOWERT NRB         41         ALCENTY         MACACA STELENTS         SS           FILLOWERT NRB         42         ADICENTY         MACACA STELENTS         SS           FILLOWERT NRB         43         ALCENTY         MACACA STELENTS         SS           FILLOWERT NRB         44         ADIAMYY         MACACA STELENTS         SS<					
SACCIMACOMUCSI CEE, 400         AACDEFEMILIAMINGQRESSTIVVWYY         GADDS MORHLÄ         599           SACCIMACOMUCSI SCH, 400         MP         ERITOSIERS NALD, 542         511           PICHIA TIPREL         401         LAM SPY         ERITOSIERS NALD, 542           RUTLADISTICATION         401         ERITOSIERS NALD, 542         ERITOSIERS NALD, 542           RUTLADISTICATION         401         ECCEPTIELIAMINGRICUSTIVWYY         MACACA NICRA, AND SPAN, NILLOPERS STATUS, NICLAN NICRA, NICRA, NICRA, NICRA, NICRA, NICRA, AND SPAN, NILLOPERS STATUS, NILLOPERS ST					
SACCIARADWCE SEC.         40         MP         LEPLOSEREN FARAD         502           DECIDA PUPPE         421         LAM         SELLANCE         543           VILLADES MLARII         423         RLMOCENS MARINES         543           VILLADES MLARII         423         RLMOCENS MARINES         543           VILLADES MLARII         423         RLMOCENS MARINES         543           VILLADES MLARII         424         RLMOCENS MARINES         554           VILLADES MLARINE         446         ACCEPERIMILIANQUERRESTVWY         MARCACA SILENCE         553           VILLADES MLARINE         448         ACCEPERIMILIANQUERRESTVWY         MARCACA SILENCE         551           VILLION TINK         410         M         MARCACA MULATTA         551           VILLION TINK         413         NEX         MARCACA MULATTA         552           RACIDONISTIAL         424         MAQSIY         TARRENDES STALL         564           PLANTS         40-49         MARCACA MULATTA         573           SOLANDAT TURESCOM         414         EMARSY VILLANG         566           SOLANDAT TURESCOM         414         EMARSY VILLANG         561           SOLANDAT TURESCOMA         414         EMARSY VILLA			N	PHOCA VITULINA	538
PICHIA PUTERIA     402     LAMA     BERNOCERCIA SUNCENN     544       MULLADERSIA KALL     404     GEL/Q     STUTUTIO CAMBUR     545       MULLADERSIA KALL     404     GEL/Q     STUTUTIO CAMBUR     535       MULLADERSIA KALL     404     GEL/Q     STUTUTIO CAMBUR     535       MULLADERSIA KALL     404     GEL/GELIAN/PRESSTVWY     MACACA ASIMISSIE     535       MULLADERSIA KALL     407     ACCEPERHIKLIAMMANKINGRERSSTVWY     MACACA SUBSTICK     540       MURLADERSIA KALL     407     ACCEPERHIKLIAMMANKINGRERSSTVWY     MACACA SUBSTICK     540       MURLADERSIA KALL     400     M     MACACA SUBSTICK     540       MURLADERSIA KALL     400     MACACA SUBSTICK     540       MURLADERSIA KALL     412     DERMONINY     MACACA MULLATIA     543       AACCORDINATION     413     NRQ     MACACA MULLATIA     543       AACCORDINATION     420     EMACSY     MACACA MULLATIA     543       AACCORDINATION     421     DAGASY     MACACA MULLATIA     543       AACCORDINATION     421     MACACA MULLATIA     543       AACCORDINATION     431     X     MACACA MULLATIA     543       AACCORDINATION     431     X     MULLATIA     MACACA MULLATIA <t< td=""><td></td><td></td><td></td><td></td><td>539</td></t<>					539
WILLIOPSIS MEAKEI         43         KLMYSY         SEELOPORUS OCCID         545           SELIZOSACCIA ADM         44         CREQ CALU MURRETYWY         BIRNETIO CAMBLIS         530           KLDYNROM CBS LAC         44         CCEQ CALU MURRETYWY         MACACA SILINICS         533           KLDYNROM CB         477         CACDEFORMILLAMMANPQRERSSTVWYY         MACACA SILINICS         530           VILLIOPSIS CLAB         48         ACDEPORIULLAMMANPQRERSSTVWYY         MACACA SILINICS         530           VILLIOPSIS CLAB         48         ACDEPORIULLAMMANPQRERSSTVWYY         MACACA SILINICS         530           VILLIOPSIS CLAB         48         ACDEPORIULLAMMANPQRERSSTVWY         MACACA MULATIA         530           VILLIOPSIS MEAKEIS         13         NRY         MACACA MULATIA         530           SCORDUIS MERBESIS         13         NRY         MACACA SILINERS         531           SCORDUIS MERBESIS         140         MACACA SILINERS         532         MACACA SILINERS         532           SCORDUIS MERBESIS         430         C         SUMMANTORIN         545         MACACA SILINERS         533           SCORDUIS MERBESIS         430         C         SUMMANTORIN         547         572         MACACA SILINERSING					
SCHEDSACCHAPOM.         44         OHLPQ         STRUTHIC CAMELIES         50           LUTVYEROWUS BLAC.         45         CERGURADRETVWY         MACACA ASSAMESS         55           CANDIA FARARSID.         45         CERGURADRETVWY         MACACA ASSAMESS         55           CANDIA FARARSID.         45         CERGURADRETVWY         MACACA ASSAMESS         55           CANDIA FARARSID.         45         MACACA ASSAMESS         55           FIGH ADDRITTON HADR         49         M         MACACA FUBLICATION         46           VILLOPES LOLAS         48         ACDERGURAVY         MACACA FUBLICATION         51           FIGH ADDRITON HEAT         49         AFLMOTY         SIAMANG         51           FIGH ADDRITON HEAT         49         AFLMOTY         SIAMANG         51           FIGH ADDRITON HEAT         40         AFLMOTY         SIAMANG         51           FIGH ADDRITON HEAT         40         AFLMOTY         MACACA FUBLICATION         54           FIGH ADDRITON HEAT         40         C         C         CHMARASATION         54           FIGH ADDRITON         40         C         C         CHMARASATION         50           SOLANIM LOCOPES         40					
KLUYVERGMYCES LAC.         45         CKLQ         ERNAGEUS BURCP.         55           CANDDA PARASILO         467         ACCEPCHERKLIJAMMANPQRARSTYVWY         MACACA NICLA.         57           MARACA NIRGE         47         ACCEPCHERKLIJAMMANPQRARSTYVWY         MACACA NICLA.         57           MILLOYSE SLAVE         49         ACCEPCHERKLIJAMMANPQRARSTYVWY         MACACA NICLA.         53           MILLOYSE SLAVE         49         AFLMATY         MACACA NICLA.         53           MICHANNERS         41         MACACA NICLA.         54         54           MICHOPHYTON RUBE.         41         MACACA NICLA.         54           ACCONLAW MARENCE.         41         NIC         MACACA NICLATIA.         54           FILANTIS         42-49         MACACA NICLATIA.         54           FILANTIS         42-49         PAPOT IAMACACA NICLATIA.         54           FILANTIS         42-49         PAPOT IAMACACA NICLATIA.         56           FILANTIS         42-49         PAPOT IAMACACA NICLATIA.         56           FILANTIS         42-49         PAPOT IAMACACA NICLATIA.         56           FILANTIS         42-49         PARASIC NICLATIA.         50           FILANTIS         44					
CANDDA PARAPSILO.         466         CERGUIKLAMERTYWY         MACACA ABSAMENESS         556           MARSENLA MINGEL         470         ACCDEFGHIKLAMMERGERSTYWYY         MACACA SELENIS         558           TORLIDPES GLAS         488         ACCDEFGHIKLAMMERGERSTYWYY         MACACA SELENIS         558           TRICHOPHYTON MENT.         490         AFLMATY         MACACA SELENIS         561           TRICHOPHYTON MENT.         490         AFLMATY         MACACA MULATIA         562           ACCORDUILS MERSENG         413         NRY         MACACA SELECLA.         564           ACCORDUILS MERSENG         413         NRY         MACACA SELECLA.         564           FLANTIS         400-459         MACACA SELECLA.         564         MACACA SELECLA.         564           FLANTIS         400-459         MACACA SELECLA.         564         MACACA SELECLA.         564           GLANDERSENTAL         424         EMQSSY         TARSUS SELECLA.         564         MACACA SELECLA.         564           GLANTIS         400         C         C         CERTITA         570         572         572         572         572         572         572         572         572         572         572         572					
FANSENULA WINGEL47ACCERFORMULALMMENDRERSTVVWYMACACA NICRA57FORULOPIS DALAB48ACCERFORMUNRYRSSTVWXYMACACA THIBETANA59WILLIORS SUAVE49MMACACA THIBETANA59FURCHOPHYTON RUBE,412DCKMORENY54FURCHOPHYTON RUBE,412DCKMORENYMACACA A TRIGETANA50FURCHOPHYTON RUBE,412DCKMORENYMACACA A TRICATA50ACOCBOLUS IMMERSU420SSMACACA A SECICULA.56ACOCBOLUS IMMERSU420SSMACACA A SECICULA.56ALABIDOTS ITIAL424EMQSSYMACACA A SECICULA.56ALABIDOTS ITIAL424EMQSSYTARSIUS SYNCHICATA56ALABIDOTS ITIAL424EMQSSYTARSIUS SYNCHICATA56ALABIDOTS ITIAL424EMQSSYTARSIUS SYNCHICATA56ALABIDOTS ITIAL424EMQSSYTARSIUS SYNCHICATA56ALABIDOTS INTAL420CINXFUGAYFUGAY57HURNS IUTCEB422CINXFUGAYCINANARENE572HURNS IUTCEB423CINXFUGAYCINANARENE590COLALMIN LOOPELSA440CEDERFINANYCINANARENE590CONTAN441CEDERFINANYCINANARENE590ALABUN SULGARE441CEDERFINANYCINANANANANANANANANANANANANANANANANANANA					
TORUCPENS GLAB.         408         ACDE/EGNERLANPQ&SSTTVWXY         MACACA BLENDS         558           PICHA JADNI         410         M         GREEN MONREY         500           PICHA JADNI         410         M         GREEN MONREY         500           PICHA JADNI         410         M         GREEN MONREY         500           RECHOPY MORE         412         DORIXORY         MACACA MULATA         500           RECHOPY MORE         413         NRY         MACACA ANULATA         500           ACOGOLUS MURESUS         413         NRY         MACACA STUANUS         565           CLANK         428         EMX         MACACA STUANUS         565           CLANK         428         EMX         MACACA STUANUS         565           CLANK         428         EMX         LEMRE CATTA         570           SOLANK LURDEN         440         C         C         CHIMANZEE         572           SOLANK LURDEN         440         NY         GREEN         GREEN         581           FLIANTUS ANUS         441         CDEFININSSWYT         GREEN         GREEN         581           FLIANTUS ANUS         440         NY         HUMANY         GREEN					
PICHA.ADDNI         40         M         GREEN ADDRESS         560           RICHOPYTON RUBR.         41         DEGRAQRWY         NACACA.PEGCATA         561           RICHOPYTON RUBR.         41         DEGRAQRWY         MACACA.PEGCATA         562           ASCORLOS IMMERSIS         41.5         NRY         MACACA.PEGCATA         562           ASCORLOS IMMERSIS         41.5         NRY         MACACA.PEGCATA         562           ARABIDORIS THAL         424         EMQSSY         TARBIDING STRIAL         564           CILVEN MAX         428         EMX         LEMMER CUTTA         576           CILVEN MAX         424         EMQSSY         TARBIDING STRIAL         564           CILVEN MAX         428         EMX         LEMMER CUTTA         570           CILVEN MAX         424         EMQSSY         CHIMANZEE         572           LUPINUS LUTEUS         43         GITX         GITX         GITX         561           MASICA NANDUS         44         K         COERFINANCEE         572         MARANCE         591           MASICA NANDUS         440         CDERFINANCESSTVY         GRAMARUS         592           ANTICUM ASTANOUM         440         CDERFINA		408	ACDEFGHIKLMNPQRSSTTVWXY		
TRICHOPHYTON MERT.         400         AFLMATY         SIAMANG         561           RUCHOPHYTON KUBE.         413         NKY         MACACA PUSCATA         562           RENCIPUTY NR REB.         413         NKY         MACACA PUSCATA         562           RENCIPUTY NR REB.         413         NKY         MACACA PUSCATA         562           RABIDOTIS THAL         420         EMOSSY         FLANTS         MACACA PUSCATA         562           CLTDIN MAKA         428         EMX         LEMIKA CATA         573           SOLANUL I VCOPERS.         430         C         CHIMAAIZEE         573           LIANTIN STAL         424         EMOSSY         CHIMAAIZEE         573           LIANTIN STAL         424         EMOSSY         CHIMAAIZEE         573           LIANTIN STAL         424         EMOSSY         CHIMAAIZEE         572           LIANTIN STAL         430         NY         CHIMAAIZEE         573           LIANTIN STAL         430         NY         CHIMAAIZEE         573           LIANTIN STAL         440         NY         CHIMAAIXEE         563           LIANTIN STAL         444         CDEFINALINPOLYNY         CERILANTIN SALANUL         564 </td <td></td> <td></td> <td></td> <td>MACACA THIBETANA</td> <td>559</td>				MACACA THIBETANA	559
TRICHOPHYTOR RUBE,         412         DERKOQENVY         MACACA PRECATA         562           ASCOBOLUS IMMERSUS         415         NRV         MACACA PRECAULA.         564           PLANTS         400-459         MACACA PRECAULA.         564           RAREDORSTIAL         424         EMOSSY         TARSIN SWICHTA         553           RAREDORSTIAL         424         EMOSSY         TARSIN SWICHTA         556           GLYCINE MAX         428         EMOX         LEMUR CATTA         550           SOLANUA LYCOPERS         40         C         CHIMARZEE         572           SOLANUA LYCOPERS         40         C         CHIMARZEE         572           SOLANUA LYCOPERS         40         C         CHIMARZEE         572           SOLANUA LYCOPERS         400         C         CHIMARZEE         572           SOLANUA LYCOPERS         400         C         CHIMARZEE         572           SOLANUA LYCOPERS         400         RI         700         700           HELIASTUSA ANTUA         400         RIN         700         700         700           HASCUSA VINTUA         440         FINFRSW         CEPEIALPHUS MARAWSEE         710         700         70					560
PENCLULUX CHRYS         413         NRY         MACACA MULTITA         563           SCORDULS MIRESUM         420-459         MACACA PASCICULA.         564           FLANTS         420-459         SAMMIR SCUREDS         566           CLUCDIN MAX         424         EMKSSY         PARDIAMADANIS         566           CLUCDIN MAX         426         EMK         PARDIAMADANIS         566           CLUCDIN MAX         428         EMK         EMK         FLANTS         570           SOLANUM LYCOPERS         420         GINN         GERMINANS         560           SOLANUM LYCOPERS         420         GINN         GERMINANS         560           GUNNA THERSSIN 441         CEGHIRMNPSYW         GORALLA         580           GHASSICLA NAPUS         440         CEBHINNPSYWY         GORALLAN         580           GINTA CHRINPSYW         CEBHIANTUM ANDUS         441         CEBHINNPSYWY         GORALLATHONSON         592           ANASIA         420         HINPSSWY         GORALLATHONSON         592           ANALS         440         CEBHINNPSYWY         GORALLATHONSON         594           ANALS         440         CEBHINNPSYWY         GORALLATHONSON         594      <					
ASCOBULUS IMMERSUS         415         NNQ         MACACA PASCULLA, 564           PLANTS         40-499         MACACA PASCULLA, 564           PLANTS         40-499         MACACA STL'ANUS         565           PLANTS         44         EMOSSY         FLANTS         MACACA STL'ANUS         565           ARAEDONS THAL         44         EMOSSY         TARSUS STUCICLA, 564         567           SOLANUA TUERROSUM         43         X         TARSUS STUCICLA, 564         576           SOLANUA TUERROSUM         43         X         TIRANUA TUERROSUM         576           BRASSICA NAPUS         44         K         GORICLA         580           CONTINERA SP.         456         CFORHLINPSSWY         GORICLA         580           CONTIGERA SINUA         440         NSY         PLANTUS ALLANUS         801           FLANTUS ANUA         440         CEDERGMERLANUA         ALLANUA         891           CARLANTAN         440         CEDERGMERLANUA         ALLANUA         892           CARLANTAN         460         CEDERGMERLANUA         ALLANUA         892           CARLANTAN         460         CEDERGMERLANUA         ALLANUA         892           CARLANTANANUA         <					
PLANTS         420-459         MACACA STLVANUS         565           ARABIDORSIS THAL         44         EMQSSY         SAMMARI SCUREUS         566           ARABIDORSIS THAL         44         EMQSSY         LEMUR CATTA         570           CLTCINS MX         450         EMX         LEMUR CATTA         570           SOLANUL TUREURS         430         EMX         LEMUR CATTA         570           SOLANUL TUREURS         432         GINX         CHMMARZEE         572           SULANUL TUREURS         432         GINX         CHMMARZEE         572           MALSOLULARIS         440         K         GORITILIA         580           OPENOTIFIERA SP.         458         CIGHILMINESSWAY         GORANG UTAN         584           HILLANTULU AL         440         EDERKMARYNY         BESELEAHURS TRAGOC.         591           OKTA SATTUL         440         EDERKMARYNY         DAMALSUN WWW         242.14 AT EMBORN.         595           ANIMALS         469-599         CHENTRANESTWAY         GARLANUS MWW         596           ANIMALS         460-599         TRAGOLA HURNIN NOLANUS         506           CARDINGRAN MALS         460-599         TRAGOLA HURNIN MWWY         SINGLE CELL ORGANISMS					
PLANTS         420-49         SAIMER SCIENCEUS         560           ACABDOPES TAL.         424         EMQSSY         PAPRIO HAMADEYAS         567           ACABDOPES TAL.         424         EMQSSY         TARSIES SYLCHTA         568           SOLANUM TVEOPERS         430         C         C         120           SOLANUM TVEOPERS         431         X         C         PYENY CHAPMAZEE         573           SOLANUM TVERROSUM         431         X         CREMONATER         560         576           BRASSICA NAPUS         434         K         GORLILA         580         576           BRASSICA NAPUS         434         K         CEGTIFICAT, SP         436         CFGHILLPRESSENXY         GORLILA         580           CENTRICAL SP         436         CEGTIFICAT, SP         436         CEGTIFICAT, SP         436         577           CARNAY         440         NSY         CREALANTUS STALL, SP         591         591         591           MARCHANTIA POLYM         450         CEDERGRANGENSYY         CREALANTUS STALL, SP         593           MARCHANTA POLYM         450         ACDEFGHIKLLIMPORSSTVWY         CREALANTUS STALL, SP         592           CANINA         450					
ARABIDOPSIIS THAL 424 ENQSY TARSIUS SYNCHYA 558 GLYCINF MAX 428 ENX 1250 GLYCINF MAX 428 CYCLL 4250 GLYCINF MAX 426 CYCLL 4250 GLYCINF MAX 4260 GLYCINF MA	PLANTS	420-43	59		
CLTCHE MAX         428         BMX         LEMUR CATTLA         570           SOLANUM TVEDEROS         431         X         CHUMPANZEE         572           SOLANUM TVEDEROS         431         X         GIBEON         576           SOLANUM TVERCOS         431         X         GIBEON         576           BRASSICA NARUS         434         K         GORUTHEAN         576           BRASSICA NARUS         434         K         GORUTHEAN         576           BRASSICA NARUS         434         K         GORUTHEAN         570           BRASSICA NARUS         444         K         CHERINPESSICH         GORUTHEAN         580           FIRTICUA ASTRUM         444         CDERKINPOSESSWATY         DAALUSCUS DORCAS         593           ANARUS         446         CDERKINPESSICWAY         DAALUSCUS DORCAS         593           ANIMALS         440-599         CRIXINPESSICWAY         EURARY GORUS MARUS         596           ASCADIS JUM         444         ACDERGINKLIANPORESICWAY         EURARYOTIC STOPLAS         593           ASCADIS JUM EGA         460-599         CRIXINPESSICWAY         EURARYOTIC STOPLAS         696           COUSTA MIGRATORIA         470         ACDERGINKLIANP					
SOLANUM LYCOPERS.         430         C         CHIMPANZEE         572           SOLANUM TURESCOUM         431         X         PYCARD         573           LUPINUS JUTEUS         432         GINX         GIBON         576           RASSICA ANUS         434         K         GORDANIA         580           OENOTHERA SP.         436         C FORHILAPSSSWXY         ORANO LTAN         584           OENOTHERA SP.         436         C FORHILAPSSSWXY         ORANO LTAN         584           HELIANTHUS ANNUS         441         C EDERIKAMPOVWX         APPYCERSO BMALANUS         590           ORYZA SATIVA         446         FIDEROGENIK         CDERKAMPSWXY         DAALISCUS DORCAS         593           MAIAHANTA POLYM         456         CDERFORMARSWXY         DAALISCUS DORCAS         593           ANIMALS         460-399         CRYX GAZELAT         597         ORXY GAZELIA         597           ANIMALS         460-399         CRYX GAZELAT         600-9         ORXY GAZELAT         600-9           CASDARGHIASUM         460-397         CRYX GAZELAT         600-0         CASTORIALASE         600-0           CASDARGHIALSMARKULLANPQRESSTVWY         SINGLE CELLORGANISMS         600-0         CASTORIALASE </td <td></td> <td></td> <td></td> <td>TARSIUS SYRICHTA</td> <td>568</td>				TARSIUS SYRICHTA	568
SOLANUAT TUBERCSUM         431         X         PYCMY CHINPARZEE         573           BRASSICA NAPUS         434         K         GROUND         576           BRASSICA NAPUS         434         K         GORLILA         580           BRASSICA NAPUS         434         K         GORLILA         576           BRASSICA NAPUS         434         K         GORLILA         580           PHASCOLUS VULGARS         440         NSY         HUMAIN         584           PHASCOLUS VULGARS         440         CERRINAPOVWX         APPCRESS MELADPIUS MAXAVIS         590           CRICIAN ANULS         440         CERRINAPOVWX         CERLADPIUS MAXAVIS         592           AARCANNIA 444         CEDERGRIKLLIMMAPORRESSTVWY         DAMALISCUS DIACAS         593           ANIMALS         440-999         ORXY GOREUS ELLIPSIPENA         595           ASCARIS SUUM         444         ACDEFGRIKLLIMPORSSTVWXY         EUKARYOTIC CYTOPLASM 600           CARNORITADPLEE         440         ACDEFGRIKLLIMPORSSTVWXY         SINCELE CELLORGANESS         609           CARNORITADPLEE         470         ACDEFGRIKLLIMPORSSTVWXY         SINCELE CELLORGANESS         609           COLUSTA MICATORDA         470         ACDEFGRIKKLLIMPORSSTVWX					
LUPINUS LUTEUS         42         GINX         GIBEON         576           BRASSICA ANPUS         434         K         GORILLA         \$80           OENOTHERA SP.         436         CFOHILMPSSWXY         ORANGI UTAN         \$84           HELLANTHOS ANNUS         441         CEGEHIKANPQUVX         AEPVICERSMELAMPUS         \$90           TITTICUM AESTUVM         441         CDEFRONÇQSSWXYY         BORGEAPHUS THACOC.         \$91           ORAZA SATIVA         446         FINPRSW         CEPHILANCO.         \$92           LARIX         452         HH         KOBUS ELLIPSIRYKW.         \$92           LARIX         452         HH         KOBUS ELLIPSIRYKW.         \$92           LARIX         452         HH         KOBUS ELLIPSIRYKW.         \$92           ANIMALS         460-599         CAENORHILLMMNPQRESTVWY         GAZZALA KIRKI         \$96           ASCARIS SUUM         464         ACDEFGHIKLLNPQRSSTVWY         SINGLE CELL ORGANISMS         600-6           CAENORHADDI ELEG         468         ACDEFGHIKLLMPQRSSTVWY         SINGLE CELL ORGANISMS         600-6           COUSTA MIGRATORIA         477         L         PLASMODIUM FALSI.         603           COUSTA MIGRATORIA         477					
BRASICA NAPUS     44     K     CORLIA     580       CORNIG LASP.     45     CFCHILNPSSSWXY     CRANG UTAN     584       PHASEOLUS VULGARIS     440     NSY     HUMAN     582       TRITICUM AESTIVUM     444     CDEFKINPQQSSWXYY     BOSELADPUS TAKAOC.     591       ORYZA SATIVA     444     CDEFKINPQQSSWXYY     BOSELADPUS TAKAOC.     591       ORYZA SATIVA     446     FHNPRSW     CEPHALOPHUS TAKAOC.     591       ARCHANTIA POLYM     450     ACDEFGOHKLLLMMNPQRRSSTVWY     DAMALSUS DORCAS     593       ANIMALS     461     ACDEFGHIKLLINPQRSSTVWY     CRAXG AZELLA THOMSON 1594       ANIMALS     461     ACDEFGHIKLINPQRSSTVWY     EUKARYOTIC CYTOPLASM     609-       ASCARS SUUM     462     ACDEFGHIKLINPQRSSTVWY     EUKARYOTIC CYTOPLASM     609-       ASCARS SUUM     464     ACDEFGHIKLINPQRSSTVWY     ENGLE CELL ORGANIEMS     600-       ARTEMA SP.     472     EFF     AAAA     TERPATHYRE 606     600-       MUTLUS EDULIS     470     ACDEFGHIKLLINPRSSTVWY     EISKARYOTIC CYTOPLASM     609-       ACDEFGHIKLLMPROKSTVWY     EISKARYOTIC CYTOPLASM     609-     600-     600-       MUTLUS EDULIS     470     ACDEFGHIKLLMPROKSTVWY     EISKARYOTIC CYTOPLASM     600-					
OENOTHERA SP.         456         CFCHILLNPSSXVXY         ORANG TAN         584           HELLANTHUS ANNUUS         441         CEGHIKANPQUYX         AEPCERAPHUS THACOC.         591           ITTICIUM AESTUVM         444         CDEFRINCY         BOERAPHUS THACOC.         591           ORYZA SATIVA         446         FIHAPRSW         CEPHILANCOC.         591           ORYZA SATIVA         446         FIHAPRSW         CEPHILANCOC.         591           ALRIX         452         HH         COBERCIALIMMINPQURYY         GAZELLA HIOMSONI         594           ANIMALS         460-599         GRYXG AZELLA         597         GRXG AZELA         597           FASCIOLA HEPATICA         462         ADIKNPSW         TRAGELAPHUS IMBER.         598           ASCARIS SUM         464         ACDEFGHIKLLINPQRSSTVWY         FUKARTOTIC CTOPLASM         609-5           ASCARIS SUM         464         ACDEFGHIKLLINPQRSSTVWY         SINGLE CELL ORGANISMS         604-6           ADDEFGHIKLLINPQRSSTVWY         FUKARTOTIC CTOPLASM         605         605           NETHILA CLAVIPES         479         AAA         TRYANDONA BUCEL         603           NETHILA CLAVIPES         479         AAA         TRYANDONDA BUCEL         605 <td></td> <td></td> <td></td> <td></td> <td></td>					
PHASEOLUS VULGARIS 440 NSY 582 FILLANTHUS ANNUUS 441 CEGHIKKINPQVVX APPLICATION ADDITIONAL CONFIGURATION ADDITIONAL ADDI					
HELIANTHUS ANNUUS     441     CECHIKANPQVWX     AEPYCRESS MELAMPUS     590       ORYZA SATIVA     446     CDBERKMPQSSSWXYY     BOEELAPHUS TRACOC.     591       ORYZA SATIVA     446     FHMPRSW     CDBEIKAMPSSWXY     DAMALISCUS DOCAS     593       MARCHANTIA POLYM.     450     ACDEFGCHIKLLIMMNPQRRSSTVWY     GAZELLA HOMSONI     594       ANIMALS     460-599     GRZYA ALTON     596     MARQYG AZELLA     597       FASCIOLA HEPATICA     462     ADIKNPSW     TRAGELAPHUS TRACOC.     591       ASGARIS SUM     464     ACDEFGHIKLINPQRSSTVWXY     FUKARYOTIC C'TOPLASM     600-9       CABNORIABULEG     460     ACDEFGHIKLINPQRSSTVWXY     SINGLE CELL ORGANISMS     600-6       MYTLINS RULIS     470     ACDEFGHIKLINPQRSSTVWXY     SINGLE CELL ORGANISMS     600-6       OCUSTA MIGRATORIA     477     I     FACDEFGHIKLINPQRSSTVWY     PLASMORMA BEUCEI     603       NEFHILA CLAVIPES     479     AAA     TETRADINGAMA BEUCEI     605       NETRIDUR BULE     480     ACDEFGHIKLINPQRSSTVWY     PLASMORMA BEUCEI     605       NETRIDUR BULE     490     AFGEGINSSV     PLASMORMA BEUCEI     605       NETRIDUR BULE     490     ACDEFGHIKLINPQRSSTVWY     PLASMORMA BEUCEI     605       DOLOUSTA MIGRATORIA					
OR YZA SATIVA         446         FHNPRSW         CEPERIALOPPUCS MAXXV         592           ZEA MAYS         548         COEFRGHIKLILIMMPORRESSTVWY         CADAFIGORIA         593           MARCHANTIA POLYM         450         ACDEFGGHIKLILIMMPORRESSTVWY         CADEFRIPYM         595           ANIMALS         460-599         MARCHANTIA         SOLV         CADEFGHIKLINPORSSTVWY         CADEFRIKINPORSSTVWY         CADEFRIKINPORSSTVWY         CARGELAPEUS IMBER.         597           ASCARIS SUUM         464         ACDEFGHIKLINPORSSTVWY         CARNORHABANBA         SOLV         SOLVAR         SOLV	HELIANTHUS ANNUUS	441	CEGHIKMNPQVWX		
ZEA MAYS     448     COEHKMMESSWYY     DAAMLISCUS DORCAS     593       MARCHANTPOLYM     452     HH     KOBGOHKLIJMMNPQRRSSTVWY     GAZELLA THOMSONI     594       ANIMALS     460-599     ORYX GAZELLA     596     ORYX GAZELLA     597       FASCIOLA HEPATICA     462     ADIKNPSW     GRAYK GAZELLA     597       SACARIS SUUM     444     ACDEFGHIKLLINPQRSSTVWYY     EUKARYOTIC CYTOPLASM     600-9       CAENORIHABDIELEG     468     ACDEFGHIKLINPQRSSTVWYY     SINGLE CELL ORGANISMS     600-6       CAENORIHASP     472     EPS     AND     REPRUIN     600-9       CAENORIHASP     472     EPS     AND     REPRUIN     600-9       MITTUS EDULIS     470     ACDEFGHIKLINPQRSSTVWYY     SINGLE CELL ORGANISMS     600-6       LOUUSTA MIGRATORIA     471     L     PLASMODIUM FALSL     603       METRIDUN BINLE     473     AAA     TETRAMYRINA PYLRF     606       NEPHILA CLAVIPES     479     AAAA     TETRAMYRINA PYLRF     606       ADDES ALDOPICTUS     480     APECINRSV     LEISHMANIA TARENT.     609       LOUIGO ELERKRI     481     KKRKK     DICOTOSTELUM DIS.     616       APIN MELLIFERA     482     ACDDEFGHIKLLINPQRSSTVWY     PHYSARUM POLYCEPH     618 </td <td></td> <td></td> <td>CDEFKNPQQSSSWXYYY</td> <td></td> <td>591</td>			CDEFKNPQQSSSWXYYY		591
MARCHANTLA POLYM.         450         ACDEFGGHIKLILLMMNPQRRSSTVWY         GAZELLA THOMSONI         594           AMIMALS         460-599         MADQUA KIRKI         595           ANIMALS         460-599         TRACELLA         597           FASCIOLA HEPATICA         462         ADIKNPSW         TRACELLA         597           ASCARIS SUUM         464         ACDEFGHIKLINPQRSSTVWY         EUKARYOTIC CYTOPLASM         600-9           CARNORHABDLEIGG.         464         ACDEFGHIKLINPQRSSTVWY         SINCELC ECIL ORGANISMS         600-6           MYTILUS EDULIS         470         ACDEFGHIKLINPQRSSTVWY         SINCELC ECIL ORGANISMS         600-6           MOTTUS EDULIS         470         ACDEFGHIKLINPQRSSTVWY         SINCELC ECIL ORGANISMS         600-6           METRIDUM SENILE         478         X         TRTRAHYMEN PYRIF.         600           ADEDEFGHIKLINPQRSSVWY         DICHORADAR BAMBU         477         L         PLASMONOMA BRUCEI         603           ADEDEFGHIKLINPQRSSVWY         DICHORADAR ACCASSA         600         ADEDEFGHIKLINPQRSSVWY         DICHORADAR ACCASSA         600           ADPHINA PULEX         481         KKKKK         DICHORADAR ACCASSA         620         DROSOPHILA MELANO.         484         ACDEFGHIKLINPQRSSVWY         <					592
LARX452HHCOUUS ELLIPENPRYAL595ANIMALS460-599ORXY CAZELLA597FASCIOLA HEPATICA462ADIKNPSWTRAGELAFHUS IMBER.588ASCARIS SUUM464ACDEFCHIKLLNPQRSSTVWXYEUKARYOTIC CYTOPLASM600-6ARTEMA SP.472EFSSINCLE CELL ORGANISMS600-6ARTEMA SP.473ACDEFCHIKLLNPQRSSTVWXYSINCLE CELL ORGANISMS600-6ARTEMA SP.476ACDEFCHIKLLNPQRSSTVWYYSINCLE CELL ORGANISMS600-6ARTEMA SP.476ACDEFCGRIHKLLLNPQRSSTVWYYSINCLE CELL ORGANISMS600-6ARTEMA SP.478XTRYPANGOM ARUCIC 655NEFRILLA CLAVIPES479AAATERABIYMENA PYDIF.606ADIS MELLPERA480AFCINRSVLEISTEMANIA TARENT.609LOLIGO BLEEKKERI481KKKKKDICTYOSTELIUMDIS.610DARSONPHILA VILLAY482ACDEFGHIKLLNPQRSSVWYPHYSARLWPDIX/CEPH 618DARSONPHILA VILLAY483ACDEFGHIKLLNPQRSSVWYPHYSARLWPDIX/CEPH 618DARSONPHILA VIRLIS484ACDEFGHIKLLNPQRSSVWYCANDIDA CLECASSA.621DROSOPHILA VIRLIS485ACDEFGHIKLLNPQRSSVWYPHYSARLWPDIX/CEPH 618631DROSOPHILA VIRLIS485ACDEFGHIKLLNPQRSSVWYPHYSARLWPDIX/CEPH 62632ASTERINA POETNA485ACDEFGHIKLLNPQRSSTVWXYPHYSARLWPDIX/CEPH 62632PROTOPTERUS DOLLOI489ACDEFGHIKLLNPQRSSTVWYPLANTS670-7CORRACEUS SOLIA400ACDEFGHIKL					
ANIMALS 460-599 CRATERIA 297 ANIMALS 460-599 CRATERIA 297 PASCIGLA HEPATICA 462 ADIKNPSW TRAGELAPHUS IMBER. 398 TRAGELAPHUS IMBER. 398 ASCARIS SUUM 464 ACDEFCHIKLLNPQRSSTVWXY EUKARYOTIC CYTOPLASM 660-9 ACDEFCHIKLLNPQRSSTVWXY SINGLE CELL ORGANISMS 606-6 ACDEFCHIKLLNPQRSSTVWXY SINGLE CELL ORGANISMS 606-6 ACDEFCHIKL 464 ACDEFCHIKLLNPQRSSTVWXY SINGLE CELL ORGANISMS 606-6 ACDEFCHIKL 464 ACDEFCHIKLLNPQRSSTVWY SINGLE CELL ORGANISMS 606-6 ACDEFCHIKL 464 ACDEFCHIKLLNPQRSSTVWY SINGLE CELL ORGANISMS 606-6 ACDEFCHIKLLNPQRSSTVWY SINGLE CELL 006-6 ACDEFCHIKLLNPQRSSTVWY SINGLE CELL 006-7 ANDPHELSS QUADRIM 505 ACDEFCHIKLLNPQRSSTVWY SINGLE CANDIDA ALBICANS 690 ANAS PLATTRATYNCS 507 ACDEFCHIKLLNPQRSSTVWY SINGLE CANDIDA ALBICANS 690 ANAS PLATTRATYNCS 507 ACDEFCHIKLLNPQRSSTVWY SINGLA FRACHOM 672 ANDORHUA SINGLE CELL 006-75 ACDEFCHIKLLNPQRSSTVWY SINGLE 764 ACDEFCHIKLLNPQRSSTVWY SINGLE 764 ACDEFCHIKLLNPQRSSTVWY SINGLA 706 ACDEFCHIKLLNPQRSSTVWY SINGLE 764 ACDEFCHIKLLNPQRSSTVWY SINGLA 765 ACDEFCHIKLLNPQRSSTVWY SINGLA 765 ACDEFCHIKLLNPQRSSTVWY SINGLA 765 ACDEFCHIKLLNPQRSSTVWY SINGLA 765 ACDEFCHIKLLNPQRSSTVWY SINGLA 765 ACDEFCHIKLLNPQRSSTVWY					
ANIMALS 460-599 ORY GAZELLA 597 FASCIOLA HEPATICA 462 ADIKNPSW TRAGELATHUS IMBER. 598 ASCARIS SUUM 464 ACDEFEHIKLLNPQRSSTVWXY ASCARIS SUUM 464 ACDEFEHIKLLNPQRSSTVWXY CANOBAMBDI ELEG. 470 ACDEFEHIKLLNPQRSSTVWYY MYTLUX EDULIS 470 ACDEFEHIKLLNPQRSSTVWYY SINGLE CELL ORGANISMS 600-6 ARTEMIA 82 ACDEFEHIKLLNPQRSSTVWYY SINGLE CELL ORGANISMS 600-6 AND FUNGI PSUDORGANA BAMBU 10 CUSTA MIGRATORIA 476 ACDEFEGHIKLLNPQRSSTVWYY SINGLE CELL ORGANISMS 600-6 AND FUNGI CUSTA MIGRATORIA 477 ACDDEFGGHIKLLNPQRSSTVWYY SINGLE CELL ORGANISMS 600-6 ACDES ALBOPICTUS 480 AEFGLINRSV LOLIGO BLEEKRI 481 KKKKK DICTYOSTELLW 58 ACDEFGHIKLLNPQRSSTVWYY PHYRANUM POLYCEPH 618 APIS MELLIFERA 482 ACDDEFGHIKLLNPQRSSTVWYY NEUROSOPHILA MELANO 484 ACCDEFGHIKLLNPQRSSTVWYY PHYROPHTHORA PAR 50 DROSOPHILA MELANO 484 ACCDEFGHIKLLNPQRSSTVWYY PHYROPHTHORA PAR 52 DROSOPHILA VARUBA 485 ACDEFGHIKLLNPQRSSTVWYY PHYROPHTHORA PAR 52 DROSOPHILA VARUBA 485 ACDEFGHIKLLNPQRSSTVWYY PHYROPHTHORA PAR 52 DROSOPHILA VARUBA 485 ACDEFGHIKLLNPQRSSTVWYY PHYROPHTHORA PAR 52 DROSOPHILA VARUBA 54 ACDEFGHIKLLNPQRSSTVWYY PHYROPHTHORA PAR 52 DROSOPHILA VARUBA 54 ACDEFGHIKLLNPQRSSTVWYY PHYROPHTHORA PAR 52 DROSOPHILA VARUBA 54 ACDEFGHIKLLNPQRSSTVWYY CANDIDA ALBICANS 55 ACCHAROMYCES CER 50 ACDEFGHIKLLNPQRSSTVWYY CANDIDA CLARS 55 ACCHAROMYCES 55 ACCHAROM 55 ACCDEFGHIKLLNPQRSSTVWYY CANDIDA CLARS 55 ACCHAROMYCES 55 ACCHAROM 55 ACCEFGHIKLLNPQRSSTVWYY CANDIDA CLARS 55 ACCHAROMYCES 55 ACCHAROMYCES 55 ACCHAROM 56 ACDEFGHIKLLNPQRSSTVWYY CANDIDA COLLARIS 55 ACCHAROM 56 ACDEFGHIKLLNPQRSSTVWYY CANDIDA 55 AC		432	hh		
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FASCICLA HEPATICA442ADIKNPSWASCARIS SUUM444ACDEFGHIKLLNPQRSSTVWXYEUKARYOTIC CYTOPLASM600-6ASCARIS SUUM440ACDEFGHIKLLNPQRSSTVWYYSINGLE CELL ORGANISMS600-6ARTEMIA SP.470ACDEFGHIKLLMPQRSSTVWYYAND FUNGI601-6ARTEMIA SP.470ACDEFGHIKLLLNPPQRSSTVWYYAND FUNGI603METRIDUM SENLE476ACDEFGGHIKKLLLNPPQRSSTVWYYPLASMODIUM FALSI.603METRIDUM SENLE478XTETRAHTMENA PTRF.604AEDES ALBOPICTUS480AEFGINRSVLEISHMANIA TARENT.609LOLIGO BLEEKERI481KKKKKDICTYOSTELLUM DIIS.616APRIS MELLIFERA482ACDDEFGHIKLLMPQRSSVWYPHYSARUM POLYCEPH.618DATHINA PULEX483IQVWXYNEUROSPORA CRASSA.621DROSOPHILA VIRLIS486ACDEFGHIKLLMPQRSSTVWXYPHYSORPORA CRASSA.621DROSOPHILA VIRLIS486ACDEFGHIKLLMPQRSSTVWYYPHYSARUMOLYCES CER.628PROTOPTERUS DOLLOT488ACDEFGHIKLLMPQRSSTVWYYCANDIDA ALBICANS621PROTOPTERUS DOLLOT499ACDEFGHIKLLMPQRSTVWYYSCHIZOSACCHA.POM637CERATTIS CAPITAT501ACDEFGHIKLLMPQRSTVWYYSCHIZOSACCHA.POM637ASTERNA PECTINI.501ACDEFGHIKLLMPQRSTVWYYSCHIZOSACCHA.POM637ASTERAS FORBESII502ACDEFGHIKLLMPQRSSTVWYYCHLAMYDIA TRACHOM.670-71ANDPHLES QUADIM503ACDEFGHIKLLMPQRSSTVWYYCHLAMYDIA TRACHOM. <t< td=""><td></td><td></td><td></td><td></td><td></td></t<>					
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ARTEMIA SP.       472       EFS       AND FUNGI         LOCUSTA MIGRATORIA       476       ACDDEFGGHIKKLLLIAPPQRSSTTVWXY       PLASMODIUM FALSI.       603         PSEUDOREGMA BAMBU.       477       L       PLASMODIUM FALSI.       603         METRIDIUM SENILE       478       X       TRYPANOSOMA BRUCEI.       603         METRIDIUM SENILE       478       X       TRYPANOSOMA BRUCEI.       603         ADDE SALBOPICTUS       480       AEFGLNRSV       LEISIMANIA TARENT.       606         LOLIGO ELEEKERI       481       KKKK       DICTYOSTELUIM DIS.       616         APIS MELLIFERA       482       ACDDEFGGHIKKLLMPQRSSVWY       PHYSARUM POLYCEPH.       618         DAPINIA PUEX       483       ACDDEFGGHIKKLLMPQRSSTWWXY       PHYSARUM POLYCEPK.       616         DROSOPHILA VIKULS       486       IQV       PODOSPORA ANSERINA       622         DROSOPHILA VIKULS       486       IQX       PODEFGGHIKKLLMPQRSSTWWYY       PHYDPHTIORA RAR.       622         DROSOPHILA VIKULS       486       IQDEGLILNPQTVWYY       SCHIZOSACCHA POM       632         PROTOPTERUS DOLLOI       491       ACDEFGHIKLLMPQRSSTWWY       CANDIDA CYLUNDRA.       637         CERATTITS CAPITATA       501       ACDEFGHIKLLN					
LOCUSTA MIGRATORIA 476 ACDEFGGHIKKLLLNPPQRSSTVWXY PERUDARGMA BAMBUI 477 L METRIDIUM SENILE 478 X TRYPANOSOMA BRUCEI 605 NEPHILA CLAVIPES 479 AAA TRYPANOSOMA BRUCEI 605 NEPHILA CLAVIPES 479 AAA DEFGAINSV LEISIMANIA TARENT. 660 LOLIGO BLEEKERI 481 KKKK DICTYOSTELUM DIS. 616 DAPIS MELLIPERA 482 ACDDEFGHIKLLNPQRSSVWY DICTYOSTELUM DIS. 616 DAPIS MELLIPERA 482 ACDDEFGHIKLLNPQRSSVWY DICTYOSTELUM DIS. 616 DAPIS MELLIPERA 482 ACDDEFGHIKLLNPQRSSVWY DICTYOSTELUM DIS. 616 DAPIS MELLIPERA 482 ACDDEFGHIKLLNPQRSSTVWXY DPHYTOPHTHORA PAR. 622 DROSOPHILA VIRLIS 488 ACDEFGHIKLLNPQRSSTVWXY PHYTOPHTHORA PAR. 622 DROSOPHILA VIRLIS 488 ACDEFGHIKLLNPQRSSTVWY PHYTOPHTHORA PAR. 623 ASTERNOCHARCEUS 498 ACDEFGHIKLLNPQRSTVWY SCHIZOSACCHAROWTCSE CER. 628 ASTERNOCHRACEUS 498 ACDEFGHIKLLNPQRSTVWY SCHIZOSACCHAROMTCSE CER. 638 ASTERNOGUN ASTERNOGUN ASTERNOGUN 499 ACDEFGHIKLLNPQRSSTVWY PHANTS 670-7 CYPRINUS CALPITAT 400 ACDEFGHIKLLNPQRSSTVWY PHANTS 670-7 CYPRINUS CARPIO 503 ACDEFGHIKLLNPQRSSTVWY PHANTS 670-7 CYPRINUS CARPIO 503 ACDEFGHIKLLNPQRSSTVWY PHANTS 670-7 CYPRINUS CARPIO 504 ACDEFGHIKLLNPQRSSTVWY PHASEOLUS VULGARIS 690 ANAS PLATYRHYNCOS 507 ACDEFGHIKLLNPQRSSTVWY PHASEOLUS VULGARIS 750-9 CHACRONTALS 513 ACNWY TRTICUM ASSTICA 706 CACHACBUS 514 ACNWY TRTICUM ASSTICA 706 CACHACBUS 514 ACNWY CHACAST 515 ACNWY SOTHABARD 515 ACNWY SOTHABARD 516 ACPURATION 527 ACDEFGHIKLLNPQRSSTVWY PHALMODER 528 ACDEFGHIKLLNPQRSSTVWY DROSOPHILA MELANN 730 ACDEFGHIKLLNPQRSSTVWY					600-66
PSEUDOREGMA BAMBU. 477 L METRIDIUM SEMLE 478 X NERTRIDIUM SEMLE 478 X AEDES ALBOPICTUS 480 AEFGLNRSV LEISHMANIA TARENT. 600 LOLIGO BLEKERI 481 KKKK DICIYOSTELLUM DIS. 616 APIS MELLIFERA 482 ACDDEFGHIKKLLMPQRSSVWY NEUCROSPORA CRASSA 620 DROSOPHILA VILLA VAKUBA 484 ACCDEFGHIKKLLAQRSSTVWXYY PHYSRAUM POLYCEPH 618 DROSOPHILA VILLA VAKUBA 488 ACDEFGHIKKLLAQRSSTVWXY PHOTOPHTORA PAR. 622 DROSOPHILA VILLA VILLS 496 IQX CANDIDA ALBICANS 621 DROSOPHILA VILLA VILLS 496 IQX CANDIDA ALBICANS 621 DROSOPHILA VILLA VILLS 496 IQX CANDIDA CLEFGHIKKLLMPQRSSTVWY PROTOPTERUS DOLLOI 498 ACDEFGHIKKLLMPQRSTVWY SCHIZOSACCHA.POM 632 ASTERNA PECTINI. 500 ACDEFHIKILMPQRSTVWY CANDIDA CULINDRA. 637 CERATTIS CAPITATA 501 AEFNRS CECOHLACKEUS 498 ACDEFGHIKKLLNPQRSTVWY CANDIDA CULINDRA. 637 CERATTIS CAPITATA 501 AEFNRS CECOHLACKUS 496 ACDEFGHIKKLLNPQRSTVWY CANDIDA CULINDRA. 637 CYPRINUS CARPIO 503 ACDEFHIKKLNPQRSSTVWXY PLANTS 670-7 CYPRINUS CARPIO 503 ACDEFHIKKLNPQRSSTVWXY PARACENTROTUS LIV. 504 ACDEFGHIKKLNPQRSSTVWXY PHARAENTROTUS 507 ACDEFFGHIKKLNPQRSSTVWY PHARAENTROTUS 507 ACDEFFHIKKLNPQRSSTVWY PHARAENTROTUS 507 ACDEFFHIKLLNPQRSSTVWY PHILANDER ASP. 710 GADUS MORHUA 510 ACDEFFHIKLLNPQRSSTVWY PHILANDER ASP. 710 GADUS MORHUA 510 ACDEFFHIKLLNPQRSSTVWY PHILANDER ASP. 710 GADUS MORHUA 510 ACDEFFHIKLLNPQRSSTVWY PHILANDER 513 ACNWY TRITCUM MSTILW 720 CRACCODVLUS POROSUS 514 ACNWY TRITCUM MSTILW 720 CRACCODVLUS POROSUS 514 ACNWY TRITCUM MSTILW 720 CRACCODVLUS POROSUS 514 ACNWY TRITCUM MSTILW 720 CARDITA CARETTA 515 ACONY TRITCUM MSTILLA 750 PODOCOLUS POROSUS 514 ACNWY TRITCUM MSTILW 720 CARDITA CARETA 517 ACNWY TRITCUM MSTILW 720 CARDITA CAR				AND FONGI	
METRIDIUM SENILE         478         X         TRTPANOSOMA BRUCEI         605           NEPFILIA CLAVIPES         479         AAA         TETRAHYMENA PYRIF.         606           ADDES ALBOPICTUS         480         AEFCANSV         LEISHMANIA TARENT.         609           LOLIGO BLEEKERI         481         KKKK         DICTYOSTELIUM DIS.         616           APIS MELLIFERA         482         ACDDEFGHIKLLMPQRSSTVWY         PHYSARUM POLYCEPH         631           DARSOPHILA MELANO.         484         ACCEDDEFGGHIKKLLLQRSSTVWXY         NEUROSPORA CRASSA         621           DROSOPHILA VAKUBA         488         ACCEDEFGHIKLLMPQRSSTVWXY         PHYTOPHTHORA PAR.         622           DROSOPHILA VAKUBA         488         ACDEFGHIKLLMPQRSSTVWY         PHYTOPHTHORA PAR.         624           DROSOPHILA VAKUBA         498         ACDEFGHIKLLMPQRSTVWY         SACCHAROMYCES CER.         628           PISASTER OCHRACEUS         991         ACDEFGHIKLLMPQRSTVWY         SCHIZOSACCHA.POM         632           CERATITIS CAPITATA         501         ACDEFGHIKLLMPQRSTVWY         CANDIDA CLINPOR         670-7           CYPRINUS CARPIO         503         ACDEFGHIKLLMPQRSTVWY         CANDIDA CLINPOR         670-7           ANOPHELES OLLOLU         40				PLASMODIUM FALSI.	603
NEPRILA CLAVIPES         479         AAAA         TETRAHYMENA PYRIF.         606           ADES ALBOPICTUS         480         AEFGANRSV         LESHAMAINA TARENT.         669           LOLIGO BLEEKERI         481         KKKKK         DICTYOSTELIUM DIS.         616           APIS MELLIFERA         482         ACDEGHIKLLMQRSSVWY         PHYSARUM POLYCEPH.         618           DAPINIA PULEX         483         IQUWXY         NEUROSOPAC CARASA         620           DROSOPHILA YAKUBA         484         ACCDEFGHIKLLAQRSSTVWXY         PHYOPHTNGAR CARASA         621           DROSOPHILA YAKUBA         488         ACDEFGHIKLLNPQRSSTVWXY         PODOSPORA ANSERINA         624           CHORISTONEURA FUM.         497         L         SACCHAROMYCES CER.         622           PROSOPHILA VIRILS         496         IQX         PODOSPORA ANSERINA         624           CHORISTONEURA FUM.         497         L         SACCHAROMYCES CER.         623           PROTOPTIREUS DOLLOI         499         ACDEFGHIKLLMPQRSSTWY         SCHIZOSACCHAPOM         637           CERATITIS CAPITATA         501         ACDEFGHIKLLNPQRSSTVWXY         CHLAMYDIA TRACHOM.         670-7           CYPRINUS CARPIO         503         ACDEFGHIKLLNPQRSSTVWY         CHLAMY	METRIDIUM SENILE	478	X		
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ALLIGATOR MISSIS     513     ACNWY     TRITICUM AESTIVUM     720       CROCODYLUS POROSUS     514     ACNWY     TRITICUM AESTIVUM     720       CROCODYLUS POROSUS     514     ACNWY     SOYBEAN     730       RANA CATESBELANA     516     ACFILNPQTWXY     SOYBEAN     730       MALACLEMYS TERRA.     517     ACNWY     ANIMALS     750-9       SPHENODON PUNCTAT.     518     ACNY     ANIMALS     756       CEPHALORHYN COM.     520     FPT     CAEDFGHIKLLNPQRSSTVWXY     BOMBYX MORI     768       CHICKEN     522     ACDEFGHIKLLNPQRSSTVWXY     BOMBYX MORI     768       ODOCOILEUS HEMIO.     524     PT     DROSOPHILA SIMUL.     780       ODOCOILEUS HEMIO.     525     FP     XENOPUS LAEVIS     792       PHILANDER SP.     527     D     CHICKEN     804					
CROCODYLUS POROSUS     514     ACNWY     TRITICUM VULGARE     724       CARETTA CARETTA     515     ACNWY     TRITICUM VULGARE     724       RANA CATESBELANA     516     ACFILNPQTWXY     ANIMALS     730       MALACLEMYS TERRA.     517     ACNWY     ANIMALS     750-91       SPHENODON PUNCTAT.     518     ACNY     ANIMALS     756-91       SPHENODON PUNCTAT.     519     ACEN     CAENORHABDL ELEG.     756       CEPHALORHYN.COM.     520     FPT     CROSSOSTOMA LACUS.     521     ACDEFGHIKLLNPQRSSTVWXY     BOMBYX MORI     768       CHICKEN     522     ACDEFGHIKLLMPQRSSTVWY     DROSOPHILA SIMUL.     780       DIDELPHIS VIRGINI.     523     DPT     DROSOPHILA SIMUL.     785       DICEROS BICORNIS     525     FP     XENOPUS LAEVIS     793       PHILANDER SP.     527     D     CHICKEN     804					
CARETTA CARETTA     515     ACNWY     SOYBEAN     730       RANA CATESBEIANA     516     ACFILNPQTWXY     ANIMALS     750-91       MALACLEWYS TERA.     517     ACNWY     ANIMALS     750-91       SPHENODON PUNCTAT.     518     ACNY     ANIMALS     750-91       EPICRATES SUBFLA.     519     ACEN     CAENORHAEDL ELEG.     766       CCPIALORHYN.COM.     520     FPT     CACDEFGHIKLLNPQRSSTVWXY     BOMBYX MORI     768       CHICKEN     522     ACDEFGHIKLLMPQRSSTVWY     DROSOPHILA MELANO.     774       DIDELPHIS VIRGINI.     523     DPT     DROSOPHILA SIMUL.     785       DICEROS BICORNIS     525     FP     XENOPUS LAEVIS     793       PHILANDER SP.     527     D     CHICKEN     804					
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SPHENODON PUNCTAT.     518     ACNY       EPICRATES SUBFLA.     519     ACEN     756       CEPHALORHYN.COM.     520     FPT     BOMBYX MORI     768       CROSSOSTOMA LACUS.     521     ACDEFGHIKLINPQRSSTVWXY     BOMBYX MORI     768       CHICKEN     522     ACDEFGHIKLINPQRSSTVWY     DROSOPHILA MELANO.     774       DIDELPHIS VIRGINI.     523     DPT     DROSOPHILA SIMUL.     780       ODOCOLEUS HEMIO.     524     PT     SQUID     785       DICEROS BICORNIS     525     FP     XENOPUS LAEVIS     792       MARMOSA SP.     526     DPT     PODOCORYNE CARNEA     793       PHILANDER SP.     527     D     CHICKEN     804			ACFILNPQTWXY		
EPICRATES SUBPLA.     519     ACEN     CAENORHABDI. ELEG.     756       CEPHALORHYN.COM.     520     FPT     BOMBYX MORI     768       CROSSOSTOMA LACUS.     521     ACDEFGHIKLLNPQRSSTVWXY     BOMBYX MORI     768       CHICKEN     522     ACDEFGHIKLLNPQRSSTVWYY     DROSOPHILA MELANO.     774       DIDELPHIS VIRGINI.     523     DPT     DROSOPHILA SIMUL.     780       ODOCOLEUS HEMIO.     524     PT     SQUID     785       DICEROS BICORNIS     525     FP     XENOPUS LAEVIS     792       PHILANDER SP.     527     D     CHICKEN     804			ACNWY	ANIMALS	750-99
CEPHALORHYN.COM.520FPTEnderstand768CROSSOSTOMA LACUS.521ACDEFGHIKLLNPQRSSTVWXYBOMBYX MORI768CHICKEN522ACDEFGHIKLLMPQRSSTVWYDROSOPHILA MELANO.774DIDELPHIS VIRGINI.523DPTDROSOPHILA SIMUL.780ODOCOLEUS HEMIO.524PTSQUID785DICEROS BICORNIS525FPXENOPUS LAEVIS792MARMOSA SP.526DPTPODCORYNE CARNEA793PHILANDER SP.527DCHICKEN804					
CROSSOSTOMA LACUS.         521         ACDEFGHIKLLNPQRSSTVWXY         BOMBYX MORI         768           CHICKEN         522         ACDEFGHIKLLMPQRSSTVWY         DROSOPHILA MELANO.         774           DIDELPHIS VIRGINI.         523         DPT         DROSOPHILA SIMUL.         780           ODOCOLLEUS HEMIO.         524         PT         SQUID         785           DICEROS BICORNIS         525         FP         XENOPUS LAEVIS         792           MARMOSA SP.         526         DPT         PODOCORYNE CARNEA         793           PHILANDER SP.         527         D         CHICKEN         804				CAENORHABDI. ELEG.	756
CHICKEN         522         ACDEFGHIKLLMNPQRSSTVWY         DROSOPHILA MELANO.         774           DIDELPHIS VIRGINI.         523         DPT         DROSOPHILA SIMUL.         780           ODOCOLEUS HEMIO.         524         PT         SQUID         785           DICEROS BICORNIS         525         FP         SQUID         785           MARMOSA SP.         526         DPT         PODOCOLVENC LAEVIS         792           PHILANDER SP.         527         D         CHICKEN         804				DOMDWY HODI	200
DIDELPHIS VIRGINI.523DPTDROSOPHILA SIMUL.780ODOCOLLEUS HEMIO.524PTSQUID785DICEROS BICORNIS525FPSQUID785MARMOSA SP.526DPTPODCORYNE CARNEA793PHILANDER SP.527DCHICKEN804					
ODOCOLLEUS HEMIO.         524         PT         SQUID         785           DICEROS BICORNIS         525         FP         XENOPUS LAEVIS         792           MARMOSA SP.         526         DPT         PODOCORYNE CARNEA         793           PHILANDER SP.         527         D         CHICKEN         804					
DICEROS BICORNIS     525     FP     XENOPUS LAEVIS     792       MARMOSA SP.     526     DPT     PODOCORYNE CARNEA     793       PHILANDER SP.     527     D     CHICKEN     804					
MARMOSA SP.     526     DPT     PODOCORYNE CARNEA     793       PHILANDER SP.     527     D     CHICKEN     804	DICEROS BICORNIS	525	FP		
				PODOCORYNE CARNEA	793
ALCODDEFGHIKKLENNNPPQQRSSSTTVWWXXY MOUSE 810					
	KAI	528	ACCIDEFGHIKKLLNNNPPQQRSSSTTVWWXXY	MOUSE	810

D D EPT ACDEFGHIKLLNPQRSSTVWXY PT ACDEFGHIKLLNPQRSTVWXY ACDEFGHIKLLNPQRSTVWXY ACDEFGHIKLLNPQRSTVWXY ACDEFGHIKLLNPQRSTVWXY DEIPQST V v V ACDEFGHIKLLMNPQRTVWY HILLMMVW HILMRW ACDEFGHIKLMNPQRTVY HLS HL HL HL F F ACDEIKNWXY HLS HLS HLS HLS HLS HL HLS HLS HLS 999 669 AILMNRRTV KKKNNQQRRRTVVY KKKNNQQRRRIVVY NQS GIKLQRRTVW AEEHKKLMNQRRSSSTTVVWWY X FLR LOD LSS D SS SS AAACDDEEEFFFGGHIIKKKLLLMMNP] QQRRRSSSSSTTTVVVWWWXXYY ADEEFHIKRRSSSVXX S 749 TW AFSSSSSSVWWXYYYY DMX LPP SSSSSSSYY N L G G YYYYY s C 999 AAADEEGGHIKKKLLLLLNPPP QQRRRRSSITVVVWXYZ AAEGK ADEEEFGGHIKKLLMNPRRSSTVVXYZ s S K AFKLNVXXYYYZ CFGSS AADDFKPPWZ ACCDEGHIKKLPPXZ

### Table 1. continued

RAT BOVINE HUMAN

916 928 999 DDEEEEEEEEFGGKLLLPPQQQQQQ SZ AEEGGGKKLLMNNPPQQQRR SSSSSTTTVVVVVVVXXYY

Source	Code	tRNA
VIRUSES	000-029	
AVIAN ONCOVIRUS		M
CHICKEN ASV/AMV/RS		W
MOUSE M-MULV PHAGE T4	018 022	PP GILPQRST
PHAGE T5		DLNPQ
ARCHAEBACTERIÁ	030-109	
HALOBACTERIUM CUT.	038	AGHNQRSTVVVX
HALOFERAX VOLCANII	050	AAACDEEFGGGGGHIIKKLLLLLMNPPP ORRRSSSTTVVWXY
HALOCOCCUS MORRHUA	054	X
METHANOBAC. THERM. SULFOLOBUS ACIDO,	062 082	GN X
THERMOPLASMA ACIDO		MX
EUBACTERIA	110-239	
MYCOPLASMA CAPRIC.	114	ACDEFGHIIKKLLLMNPQRRSSTTVWWXY
	118 125	AGIPSTVX WW
	125	X
STREPTOMYCES COEL.	131	G
STAPHYLOCOC. EPID.	138	GG
MYCOBAC. SMEG.	142	X
BACILLUS STEARO. BACILLUS SUBTILIS	146 154	FLVY AFGIKKLMPRSSSTVWXYY
THERMUS THERMOPHI.	158	DFIMXX
E.COLI	166	AAACDEEEFGGGHIIIKLLLMNQQ RRRRRSSSSSTTVVVWXXYYZ
SALMONELLA TYPHI. AZOSPIRILLUM LIPO.	170	GGHLPPP
RHODOSPIRIL. RUB.		N FL
AGMENELLUM QUADR.	206	F
	210	LLX
SYNECHOCYSTIS SP.	214	E
ORGANELLES		
CHLOROPLASTS	240-359	
CHLAMYDOMONAS REIN	244	E
EUGLENA GRACILIS		F
CODIUM FRAGILE SCENEDESMUS OBLIQ.		GKMR MXY
LUPINUS ALBUS	263	Y
HORDEUM VULGARE	264	DDEQ
TRITICUM AESTIVUM	268	E
ZEA MAYS GLYCINE MAX	272 284	I LLL
NICOTIANA TABACUM	292	W
	316	FLLLWX
SPINACIA OLERACEA	328	FIILMPTVWX
MITOCHONDRIA	360-599	
SINGLE CELL ORGANISMS		
AND FUNGI		
TETRAHYMENA PYRIF. TETRAHYMENA THERM.	380 384	FY W
NEUROSPORA CRASSA	392	W ALLTVWXY
SACCHAROMYCES CER.	400	FGHIKLMPRRSSSTWXY
PLANTS	420-459	
SOLANUM TUBEROSUM	431	IIL
OENOTHERA SP. PHASEOLUS VULGARIS	430	F FLLLLMPWXY
ANIMALS		
ASCADIS STILM	464	
	464 480	FMS
ASCARIS SUUM AEDES ALBOPICTUS LOLIGO BLEEKERI	480	FMS DEGIKQRSVX KKK
AEDES ALBOPICTUS LOLIGO BLEEKERI HAMSTER	480 481 524	DEGIKQRSVX KKK DKRS
AEDES ALBOPICTUS LOLIGO BLEEKERI	480 481 524	DEGIKQRSVX KKK

	599			
EUKARYOTIC CYTOPLASM				
SINGLE CELL ORGANISMS	600-669			
AND FUNGI				
EUGLENA GRACILIS	604			
TETRAHYMENA THERM. SCENEDESMUS OBLIQ.	608 612	QQQX FXY		
VEUROSPORA CRASSA	620	FX		
SACCHAROMYCES CER.	628			
		MNPPRRRSSSTTV FFXY	VVWXY	
SCHIZOSACCHA. POM. FORULOPSIS UTILIS	636	AILPVXY		
CANDIDA CYLINDRA.	637	LLLSSSSS -		
PLANTS	670-749			
HORDEUM VULGARE	678	EEF	· .	
WHEAT GERM		FGKMRWXYY		
BRASSICA NAPUS		F		
LUPINUS LUTEUS		EFGHIMNPSVXY		
PHASEOLUS VULGARIS PISUM SATIVUM	698 702	LLLLX F		
SPINACIA OLERACEA	704	S		
VICOTIANA RUSTICA	706	SSSSSYY		
SOLANUM TUBEROSUM	707	LW		
CUCUMIS SATIVUS	708	L		
NIMALS	750-999			
CAENORHABDI. ELEG.	756	L		
ASTERINA AMURENSIS	762	x		
BOMBYX MORI	768	AAFFGGI		
DROSOPHILA MELANO.		EFHKKSSSVVVX	Y	
SUPHAUSIA SPERBA KENOPUS LAEVIS	786 792	X DFX		
SALMON LIVER	798	X		
CHICKEN	804	w		
MOUSE	810	EFFFIKKMQQRR	√XZ	
RAT	916	DDEKKKLLNNQS	SSVVX	
RABBIT LIVER BOVINE LIVER	922	DDEKKKLLNNQS DFKKKMV DFFLLNQRRRTW F	¥7.	
CALF LIVER	934	F		
COW MAMMARY GLAND	940			
		LL		
SHEEP LIVER.		LL HX AAEFGGHLMNNG	QQSVXYYZ	
SHEEP LIVER IUMAN	946	LL HX	QQSVXYYZ	
SHEEP LIVER. HUMAN	946 999	LL HX AAEFGGHLMNN(		
SHEEP LIVER IUMAN PART THREE: tRNA and tRN	946 999 A gene se	LL HX AAEFGGHLMNNO quences that differ t		ntional a
SHEEP LIVER HUMAN PART THREE: tRNA and tRN	946 999 A gene se	LL HX AAEFGGHLMNN(		ntional a
SHEEP LIVER IUMAN PART THREE: 1RNA and 1RN Source	946 999 A gene se	LL HX AAEFGGHLMNNO quences that differ t tRNA/tRNA gene		ntional a
HEEP LIVER HUMAN PART THREE: tRNA and tRN Source ARCHAEBACTERIA	946 999 [ <b>A gene se</b> Code	LL HX AAEFGGHLMNNO quences that differ t tRNA/tRNA gene		ntional a
HEEP LIVER HUMAN PART THREE: tRNA and tRN Source ARCHAEBACTERIA	946 999 (A gene se Code 030-109	LL HX AAEFGGHLMNNO quences that differ t tRNA/tRNA gene		ntional a
HEEP LIVER HUMAN PART THREE: tRNA and tRN Source ARCHAEBACTERIA	946 999 (A gene se Code 030-109	LL HX AAEFGGHLMNNO quences that differ t tRNA/tRNA gene Z		ntional al
HEEP LIVER HUMAN PART THREE: 1RNA and 1RN Source ARCHAEBACTERIA METHANOCOCCUS JAN. MITOCHONDRIA SINGLE CELL ORGANISMS	946 999 (A gene se Code 030-109 065 	LL HX AAEFGGHLMNNO quences that differ t tRNA/tRNA gene Z		ntional al
HEEP LIVER IUMAN PART THREE: tRNA and tRN Source ARCHAEBACTERIA METHANOCOCCUS JAN.	946 999 (A gene se Code 030-109 065 	LL HX AAEFGGHLMNNO quences that differ t tRNA/tRNA gene Z		entional al
HEEP LIVER HUMAN PART THREE: 1RNA and 1RN Source ARCHAEBACTERIA METHANOCOCCUS JAN. MITOCHONDRIA SINGLE CELL ORGANISMS AND FUNGI PHYTOMONAS SP.	946 999 (A gene se Code 030-109 065 360-599 360-419 367	LL HX AAEFGGHLMNNO quences that differ 1 tRNA/tRNA gene Z		ntional al
HEEP LIVER HUMAN PART THREE: IRNA and IRN Source ARCHAEBACTERIA METHANOCOCCUS JAN. MITOCHONDRIA SINGLE CELL ORGANISMS NND FUNGI	946 999 (A gene se Code 030-109 065 360-599 360-599 360-419 367 409	LL HX AAEFGGHLMNNO quences that differ 1 tRNA/tRNA gene Z Z		ntional al
HEEP LIVER HUMAN PART THREE: 1RNA and 1RN Source ARCHAEBACTERIA METHANOCOCCUS JAN. MITOCHONDRIA SINGLE CELL ORGANISMS AND FUNGI PHYTOMONAS SP.	946 999 (A gene se Code 030-109 065 360-599 360-419 367	LL HX AAEFGGHLMNNO quences that differ 1 tRNA/tRNA gene Z Z		entional al
HEEP LIVER HUMAN PART THREE: tRNA and tRN Source ARCHAEBACTERIA METHANOCOCCUS JAN. MITOCHONDRIA SINGLE CELL ORGANISMS AND FUNGI PHYTOMONAS SP. FRICHOPHYTON MENT.	946 999 (A gene se Code 030-109 065 360-599 360-599 360-419 367 409	LL HX AAEFGGHLMNNO quences that differ 1 tRNA/tRNA gene Z Z		ntional al
HEEP LIVER HUMAN PART THREE: IRNA and IRN Source ARCHAEBACTERIA METHANOCOCCUS JAN. MITOCHONDRIA SINGLE CELL ORGANISMS AND FUNGI PHYTOMONAS SP. FRICHOPHYTON MENT. ANIMALS JOCUSTA MIGRATORIA PHS MELLIFERA	946 999 (A gene se Code 030-109 065 360-419 367 409 460-599 476 482	LL HX AAEFGGHLMNNO quences that differ 1 tRNA/tRNA gene Z Z Q E		ntional al
HEEP LIVER IUMAN PART THREE: IRNA and IRN Source ARCHAEBACTERIA METHANOCOCCUS JAN. MITOCHONDRIA SINGLE CELL ORGANISMS AND FUNGI PHYTOMONAS SP. RICHOPHYTON MENT. ANIMALS OCUSTA MIGRATORIA APIS MELLIFERA JAPHNIA PULEX	946 999 (A gene sc Code 030-109 065 360-599 360-419 367 409 460-599 476 482 483	LL HX AAEFGGHLMNNO quences that differ tRNA/tRNA gene Z Z Q E E S T C		entional al
HEEP LIVER HUMAN PART THREE: tRNA and tRN Source ARCHAEBACTERIA METHANOCOCCUS JAN. MITOCHONDRIA SINGLE CELL ORGANISMS AND FUNGI PHYTOMONAS SP. TRICHOPHYTON MENT. ANIMALS LOCUSTA MIGRATORIA APIS MELLIFERA DAPHNIA PULEX SOCOPHILA MELANO.	946 999 <b>A gene se</b> Code 030-109 065 360-419 367 409 460-599 476 482 483 484	LL HX AAEFGGHLMNNO quences that differ 1 tRNA/tRNA gene Z Z Q E S T C P		ntional al
HEEP LIVER IUMAN PART THREE: IRNA and IRN Source ARCHAEBACTERIA METHANOCOCCUS JAN. MITOCHONDRIA SINGLE CELL ORGANISMS AND FUNGI PHYTOMONAS SP. RICHOPHYTON MENT. ANIMALS OCUSTA MIGRATORIA APIS MELLIFERA JAPHNIA PULEX	946 999 (A gene sc Code 030-109 065 360-599 360-419 367 409 460-599 476 482 483	LL HX AAEFGGHLMNNO quences that differ tRNA/tRNA gene Z Z Q E E S T C		ntional al
HEEP LIVER IUMAN PART THREE: IRNA and IRN Source ARCHAEBACTERIA METHANOCOCCUS JAN. MITOCHONDRIA SINGLE CELL ORGANISMS AND FUNGI PHYTOMONAS SP. FRICHOPHYTON MENT. ANIMALS OCUSTA MIGRATORIA APIS MELLIFERA ADAPHNIA PULEX SOCOPHIA MIGRATORIA APIS MELLIFERA ADAPHNIA PULEX SALAENOPTERA PHYS. SALAENOPTERA MUSC.	946 999 (A gene se Code 030-109 065 360-419 367 409 460-599 476 482 483 484 489	LL HX AAEFGGHLMNNO quences that differ 1 tRNA/tRNA gene Z Z Q E S T C P S		ntional al
HEEP LIVER HUMAN PART THREE: IRNA and IRN Source ARCHAEBACTERIA METHANOCOCCUS JAN. MITOCHONDRIA SINGLE CELL ORGANISMS AND FUNGI PHYTOMONAS SP. RICHOPHYTON MENT. ANIMALS JOLUSTA MIGRATORIA APIS MELLIFERA DAPHNIA PULEX DROSOPHILA MELANO. PROTOPTERUS DOLLOI SALAENOPTERA PHYS. BALAENOPTERA MUSC. TALICHOERUS GRYPUS	946 999 (A gene se Code 030-109 065 360-419 367 409 460-599 476 483 483 484 483 484 499 534 535 537	LL HX AAEFGGHLMNNO quences that differ 1 tRNA/tRNA gene Z Z Q E S T C P P S S S K		entional al
HEEP LIVER HUMAN PART THREE: IRNA and IRN Source ARCHAEBACTERIA METHANOCOCCUS JAN. MITOCHONDRIA SINGLE CELL ORGANISMS AND FUNGI PHYTOMONAS SP. TRICHOPHYTON MENT. AND FUNGI PHYTOMONAS SP. TRICHOPHYTON MENT. AND FUNGI SOCUSTA MIGRATORIA PIS MELLIFERA JAPHNIA PULEX DROSOPHILA MELANO. PROTOPTERUS DOLLOI JALAENOPTERA PHYS. JALAENOPTERA PHYS. JALAENOPTERA PHYS. HOCA VITULINA	946 999 A gene sc Code 030-109 065 360-599 360-599 360-419 367 409 460-599 476 482 483 484 489 534 535 537 538	LL HX AAEFGGHLMNNO quences that differ 1 tRNA/tRNA gene Z Z Q E S T C P S S S S K S S S K S S		ntional al
HEEP LIVER HUMAN PART THREE: IRNA and IRN Source ARCHAEBACTERIA METHANOCOCCUS JAN. MITOCHONDRIA SINGLE CELL ORGANISMS NND FUNGI PHYTOMONAS SP. FRICHOPHYTON MENT. INIMALS JOCUSTA MIGRATORIA APHS MELLIFERA JOCUSTA MIGRATORIA PHYTOMONAS SP. FRICHOPHYTON MENT. INIMALS JOCUSTA MIGRATORIA APHS MELLIFERA JAPHNIA PULEX DROSOPHILA MELANO. PROTOPTERUS DOLLOI SALAENOPTERA MUSC. HALCHOERUS GRYPUS PHOCA VITULINA SIMANG	946 999 (A gene se Code 030-109 065 360-599 360-419 367 409 460-599 476 482 483 484 483 484 483 535 537 538 542	LL HX AAEFGGHLMNNO quences that differ 1 tRNA/tRNA gene Z Z Q E S T C C P S S NSS S S S		ntional al
HEEP LIVER HUMAN PART THREE: IRNA and IRN Source ARCHAEBACTERIA METHANOCOCCUS JAN. MITOCHONDRIA SINGLE CELL ORGANISMS AND FUNGI PHYTOMONAS SP. TRICHOPHYTON MENT. AND FUNGI PHYTOMONAS SP. TRICHOPHYTON MENT. AND FUNGI SOCUSTA MIGRATORIA PIS MELLIFERA JAPHNIA PULEX DROSOPHILA MELANO. PROTOPTERUS DOLLOI JALAENOPTERA PHYS. JALAENOPTERA PHYS. JALAENOPTERA PHYS. HOCA VITULINA	946 999 A gene sc Code 030-109 065 360-599 360-599 360-419 367 409 460-599 476 482 483 484 489 534 535 537 538	LL HX AAEFGGHLMNNO quences that differ 1 tRNA/tRNA gene Z Z Q E S T C P S S S S K S S S K S S		ntional al
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Table 2. Format of tRNA	sequences in t	he databank
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### PART ONE: SEQUENCES OF tRNA-GENES

Jumber				accept stem 012345678	D-domain 9111111111112		nticodon 222333333		variable region extra loop 4eeeeeeeeeeeeeeeeeee	T-domain eee44445555555555	accep stem 55666666666677777
		icodon Organism	Kingdom		012345677890	001234567	89012345	678901234	511111111234522222	222678901234567	39012345678901234
DA0260	TGC	PHAGE T5	VIRUS	-GGGCGAAT.	AGTGTCAGC-GGG	AGCACAC	CAGACTTG	CAATCTGGT	<i>A</i>	G-GGAGGGTTCG/	AGTCCCTCTTTGTCCAC
				==*=*==	*	*=====				22 25 25 18 18	=====*=*=*==
A0340	TGC	ARCHAEGLOBUS FULG.	ARCHAE		AGCTCAGCGGG				3		ATCCCGCCGAGTCCA-
				==*====							*
A0380	TGC	HALOBACTERIUM CUT.	ARCHAE	-GGGCCCAT.	AGCTCAGTGGT *===		CTCCTTTG	CAAGGAGGA'	[	GCCCTGGGTTCG/	ATCCCAGTGGGTCCA-
10420	maa	HALOBACTERIUM HAL.	ADCUAR		*=== AGCTCAGTGGT						ATCCCAGTGGGTCCA-
10420	190	HALOBACIERIUM HAL.	AKCHAE	-9999000A1	*===			CAAGGAGGA		=====	ATCCCAGIGGGICCA-
20580	TGC	METHANOBAC, FORMI.	ARCHAE		AGCTCAGACTGGG						ATCCCGGTGGGTCCA-
10000	100	THE THINNODING. FORTICE	ARGUAD	==*===*				=====		GCCCCGGG11CM	=====*===*==
40620	TGC	METHANOBAC. THERM.	ARCHAE	-GGGCCCGT	AGCTCAGACTGGG			CAAGGCGGA			ATCCCGGTGGGTCCA
10020	100		THOM ID	==*===*	====	====		=====	5	=====	*
0650	TGC	METHANOCOCCUS JAN.	ARCHAE	-GGGCCCGT	AGCTCAGCT-GGG	AGAGCGC	CGGCCTTG	CAAGCCGGA	} <b></b>	GCCGTGGGTTCA	ATCCCACCGGGTCCA
					====	=====				=====	========*==
0651	GGC	METHANOCOCCUS JAN.	ARCHAE	-GGGCTGGT	AGCTCAGACTGGG	AGAGCGC	CGCATTGG	CTGTGCGGA	]	GCCGCGGGGTTCA	ATCCCGCCCAGTCCA
				*	====						*
10660	TGC	METHANOCOC.VANI.	ARCHAE	-GGGCCCGT	AGCTCAGTT-GGG	AGAGCGC	TGCCCTTG	CAAGGCAGA	3	GCCGTGGGTTCA	ATCCCGCCGGGTCCA
				*						=*===	**
10670	TGC	METHANOTHRIX SOEH.	ARCHAE	-GGGCTTGT/	AGCTCAGCT-GGT	AGAGCGC	CGCCTTTG	CAAGGCGGA	}	GCCCTGGGTCCGA	ATCCCAGCAAGTCCA
				*	====	=					============
0680	TGC	METHANOTHERM. FER.	ARCHAE	-GGGCCCAT	AGCTCAGCCTGGG	AGAGCGC	CGCCCTTG	CAAGGCGGA	3	GCCCCGGGTTCAA	ATCCCGGTGGGTCCA
				==*====							*
0780	TGC	METHANOSPIR. HUNG.	ARCHAE	~GGGCTCGT	AGCTCAGCT-GGA	AGAGCGC	GGCGTTTG	CAACGCCGA	3	GCCTGGGGTTCA	ATCCCCACGGGTCCA
				==*=*==							*_*_*_=
10940	TGC	THERMOCOCCUS CELER	ARCHAE		AGCTCAGCCTGGG	AGAGCGI	CGGCTTTG	CAAGCCGAA	}	GCCCCGGGTTCGF	ATCCCGGCCGGTCCA
				==*====	====		====				=====*==
10980	TGC	THERMOPROT. TENAX	ARCHAE		AGTCTAGCGGA			CGCGCGGGA	3	ATCCCGGGTTCGA	ATCCCGGCCGGTCCA
				*	===*	*=== =					*
\0981	CGC	THERMOPROT. TENAX	ARCHAE	-GGGCCGGT/	AGTCTAGCGGA	AGGACGC *=== =		CGCGCGGGGA	}	ATCCCGGGTTCGA	ATCCCGGCCGGTCCA-
1110	TGC	BARTONELLA ELIZAB.	EUBACT	-GGGGCCGT	AGCTCAGCT-GGG			CAAGCAGGG	}		TCCCGTCCGGCTCCA
					====	==== =		=====	-	= ===	=== =====*==
41130	TGC	BARTONELLA OUINT.	EUBACT	-GGGGCCGT/	AGCTCAGCT-GGG	AGAGCAC	CTGCTTTĠ	CAAGCAGGG	}		TCCCGTCCGGCTCCAC
		L		*	====	=====		=====	-	= ===	=== =====*==

# RESULTS

### **Presentation of sequences**

The sequences in the database are divided into three parts. The first two parts contain the sequences of the tRNA genes and tRNAs, respectively, which can be fitted into the canonical tRNA alignment. The third part lists tRNA and tRNA gene sequences, mainly of animal mitochondria, whose secondary structures differ from most tRNAs and could not be aligned according to Figure 1.

An example for sequence presentation in the database is given in Table 2. Each sequence in the compilation occupies two consecutive lines. The first line begins with the letter 'D' or 'R' and contains the six-position identification code of the sequence ('D' or 'R' for DNA or RNA, respectively; a one-letter code for the amino acid, X for methionine-initiator, Z for selenocysteine; and the four-digit code specifying the organism and isoacceptor. After this, the sequence of the anticodon (in the case of tRNA sequences in its modified form) is given, followed by the name and the kingdom of organism (Table 1), and the sequence (99 standard positions). The second line begins with the sign '+' and contains the information about base-pairing (double helical regions only, tertiary interactions are not annotated). All other lines in the compilation begin with signs other than 'D,' 'R' or '+' (usually '\*') and contain comments.

Nucleotides involved in Watson–Crick pairs are marked with '=', the GU pairs are indicated with the sign '\*'. Nucleotides 26 and 44 are considered to form a base-pair included in the anticodon stem (Fig. 1).

The sequences in orginal publications denoted as 'yeast' are assigned to *Saccharomyces cerevisiae*. The user should be aware, however, that some of these organisms have possibly been misclassified and that the original literature should be consulted.

This compilation uses a one-letter code for all nucleotides including modified ones. For standard nucleotides, adenosine, cytidine, guanosine, thymidine and uridine the usual abbreviations, A, C, G, T and U, respectively, are used. To designate modified nucleotides, the other ASCII signs are employed as defined in Table 3. Terminology and structure of the modified nucleosides occurring in tRNAs were used according to refs 2 and 3. Positions in particular sequence which are not filled (gaps in the generalised structure, Fig. 1) are indicated by a dash. All nucleotide insertions are denoted by underlining at the place of insertion.

### Numbering and alignment of the variable region

The alignment of the variable region has been done in accordance with Steinberg and Kisselev (4). The extra arm is placed between nucleotides 45 and 46. It includes two double helical strands forming a stem and a loop. The annotations of the nucleotides in the extra arm positions begin with the letter 'e' (extra) followed by a one- or two-digit number. We have reserved a space for 7 bp in the stem and 5 nt in the loop. The nucleotides in the loop are numbered from 1 to 5, whereas the nucleotides in the stem are numbered from 11 to 17 (5'-branch) and from 27 to 21, in the reverse order, (3'-branch), to indicate base-pair formation between nucleotides 11–21, 12–22, etc. (Fig. 1). In the tRNAs where the extra arm position 45 is empty but where the nucleotides 46–48 between the extra arm and T-domain are present, the positions will be filled in the order 48, 46,

Table 3. Modified nucleosides in tRNA and their abbreviations

	ter code of nucleotides			?G	unknown modified guanosine
V			S	Gr(p)	2'-O-(5-phospho)ribosylguanosine
	Symbol [2,3]		K	mlG	1-methylguanosine
	V		L	m2G	N <sup>2</sup> -methylguanosine
		Name [2,3]	#	Gm	2'-O-methylguanosine
		V	R.	m22G	$N_{2}^{2}$ , $N_{2}^{2}$ -dimethylguanosine
			<u> </u>	m22Gm	N <sup>2</sup> ,N <sup>2</sup> ,2'-O-trimethylguanosine
U	U	uridine	7	m7G	7-methylguanosine
С	C	cytidine	(	fa7d7G	archaeosine
А	A	adenosine	Q	Q	queuosine
G	G	guanosine	8	manQ	mannosyl-queuosine
Т	Т	thymine (for sequences of tRNA genes only)	9	galQ	galactosyl-queuosine
-		empty position	Y	yW	wybutosine
(und	lerline)	insertion (see footnote for further information)	W	o2yW	peroxywybutosine
		unknown nucleotide			
			N	?U	unknown modified uridine
Н	?A	unknown modified adenosine	{	mnm5U	5-methylaminomethyluridine
н	mlA	1-methyladenosine	2	s2U	2-thiouridine
1 .	m2A	2-methyladenosine	J	Um	2'-O-methyluridine
+	i6A	N <sup>6</sup> -isopentenyladenosine	4	s4U	4-thiouridine
*	ms2i6A	2-methylthio-N <sup>6</sup> -isopentenyladenosine	&	ncm5U	5-carbamoylmethyluridine
=	mбA	N <sup>6</sup> -methyladenosine	1	mcm5U	5-methoxycarbonylmethyluridine
6	tбA	N <sup>6</sup> -threonylcarbamoyladenosine	S	mnm5s2U	5-methylaminomethyl-2-thiouridine
Е	m6t6A	N <sup>6</sup> -methyl-N <sup>6</sup> -threonylcarbamoyladenosine	3	mcm5s2U	5-methoxycarbonylmethyl-2-thiouridine
[	ms2t6A	2-methylthio-N <sup>6</sup> -threonylcarbamoyladenosine	v	cmo5U	uridine 5-oxyacetic acid
:	Am	2'-O-methyladenosine	5	mo5U	5-methoxyuridine
Ι	I	inosine	1	cmnm5U	5-carboxymethylaminomethyluridine
0	mlI	1-methylinosine	\$	cmnm5s2U	5-carboxymethylaminomethyl-2-thiouridine
^	Ar(p)	2'-Q-(5-phospho)ribosyladenosine	х	acp3U	3-(3-amino-3-carboxypropyl)uridine
•	io6A	N <sup>6</sup> -(cis-hydroxyisopentenyl)adenosine		mchm5U	5-(carboxyhydroxymethyl)uridinemethyl ester
			)	cmnm5Um	5-carboxymethylaminomethyl-2'-O-methyluridin
< -	?C	unknown modified cytidine	~	ncm5Um	5-carbamoylmethyl-2'-O-methyluridine
%	s2C	2-thiocytidine	D	D	dihydrouridine
В	Cm	2'-O-methylcytidine	P	Ψ	pseudouridine
M	ac4C	N <sup>4</sup> -acetylcytidine	1	n mlΨ	1-methylpseudouridine
?	m5C	5-methylcytidine	] 7		
1	m3C	3-methylcytidine	- T	Ψm	2'-O-methylpseudouridine
}	k2C	lysidine		m5U	ribosylthymine
>	fSC	5-formylcytidin	F	m5s2U	5-methyl-2-thiouridine
0	f5Cm	2'-O-methyl-5-formylcytidin	N .	m5Um	5, 2'-O-dimethyluridine

47, i.e., tRNAs use position 48, 46 and 47 for the first, second and third nucleotide, respectively, depending on the length of the sequence in this region. A similar situation occurs in tRNAs without a long extra arm, where the most variable position 47 is deleted in many sequences.

## Alignment of animal mitochondrial tRNAs

In properly aligned tRNA sequences, nucleotides occupying the same position in different tRNA sequences should play a comparable structural or functional role. Most animal mitochondrial tRNAs cannot be easily aligned with other tRNAs mainly because of the absence of information on their three-dimensional structure. Experimental data, however, point to the existence of tertiary interactions in these tRNAs. In this compilation, we use an alignment which accounts for these interactions as much as possible. Where we could do so, the animal mitochondrial tRNAs were included in Parts I and II. The alignment of animal mitochondrial tRNA is, however, not yet unambiguous.

Some animal mitochondrial tRNAs have completely unusual secondary structure and cannot be fitted in the tRNA alignment used here (Parts I and II). We treated these sequences separately including them into Part III. Here, each particular sequence has its own

alignment. To this group belong the tRNAs from: (i) mitochondria of a parasitic worm lacking the T- or D-domain, (ii) mitochondria of mollusks, insects and echinoderm, with extended anticodon and T-stems and (iii) mammalian mitochondria, lacking the D-domain.

For some tRNA genes the secondary structure pattern cannot be clearly established. We have also included these sequences in Part III. It is possible that posttranscriptional modifications of these tRNAs will result in improvement of the secondary structure.

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