

Supplementary Figure 9.

Clustal Omega sequence alignment of DNA-PKcs from selected metazoan plus putative archaeon sequences.

Panel A: Percent identity of sequences from Clustal Omega. Common names or alternative names are shown in (). See Supplementary Table 1 for full list of organisms, scientific names and accession numbers.

Sequence	% Identity
HUMAN	100
MOUSE	79.3
TASDEVIL (TASMANIAN DEVIL)	76.76
PLATYPUS	75.02
TURTLE	71.88
ALLIGATOR	70.21
OSTRICH	69.71
GECKO	68.56
CANARY	67.87
CAECIL (AMPHIBIAN)	67.78
SNAKE	66.5
LATIMERIA (COELACANTH)	65.32
STERLET (FISH)	64.8
XENOPUS	64.31
BAMBOO (BAMBOO SHARK)	62.27
MILII (ELEPHANT SHARK)	62.14
GAR (FISH)	61.77

Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

DANIO (FISH)	58.42
BELCHER (LANCELET)	43.4
HEMICHOR (HEMICHORDATE)	42.68
STARFISH	42.66
NEMATOSTELLA (SEA ANEMONE)	41.94
PISTILLATA (STONY CORAL)	41.19
STRONG (SEA URCHIN)	41.07
SOFT CORAL	39.91
POMACEA (SNAIL)	39.44
CRASSO2 (OYSTER)	39.43
PRIAPULA (WORM)	39.18
TRICHOPLAX (PLACAZOA)	39.01
CAPITELLA (WORM)	37.29
SPONGE	35.34
SCORPION	34.27
MUDCRAB	29.72
"PUTATIVE ARCHAEON"	21.58

Panel B: Clustal Omega alignment of DNA-PKcs sequences from selected metazoans compared to putative archaeon.

Sequences of selected Metazoans as in Supplementary Figure 2. Sequence names and classification are described in Supplementary Table 2. Colours representing identical, conserved and semi-conserved amino acids, phosphorylation sites and catalytic amino acids are as in Supplementary Figure 2. The putative archaeon sequence accession numbers and the amino acid numbers of the corresponding start and end of each putative archaeon sequences on the human DNA-PKcs sequence is indicated below and in bold/black on the alignment in the following pages.

Archaeon Accession number	Corresponding residue number in human sequence (start)	Corresponding residue number in human sequence (end)
RYG70452.1	1	291
RYG70451.1	292	1187
RYG70450.1	1188	3274
RYG70459.1	3275	4128

Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

CLUSTAL O(1.2.4) multiple sequence alignment

	Start RYG70452.1 (Archaeon)	
ARCHAEON	-----MEALEKLLLEDLNRVETEDA---AVNVASLVASVEA	33
MUDCRAB	-----MASGGREDVQDLEKLLHHYSSGN-ELRNARSARDIVVDISE	40
SCORPION	-----MNEITNSLHENILKLNDFIKYQK--DEGHSSIIYVIKDISE	38
SPONGE	-----MESRIESLWESLHSSS-PQRYSYATEVASDLYS	32
CAPITELLA	-----MARALQEQLAGLVSDTRGQPGVNNARISHESIGNIGA	37
DANIO	-----MAADTSTVGGIQGYLLKLLHSSLEDTVSTNVAIVCHDIIGDLGQ	43
MILII	-----MAGPRGAAADTLSAFASKLHLLSLSDVKSAAAESHSAVGSISR	43
BAMBOO	-----MADGMRRHGAGVGLVERRLQOLEQLLSAQDSRSAAVESHIVANLTH	48
XENOPUS	MLLAGAGGSSGDGDGQDVASGPAESAAGILGRLHQLHGLLSLE-SGVGAEGAHSLLHNLAE	59
STERLET	-----MAQPGSCSVGAGGIQGNLHKLHSLFNATDAKSAAVESHNLIGNLGQ	46
GAR	-----MAGSGGGIQGYLQKLLHSLCGAGETKQTALECHSVIGDLGQ	40
LATIMERIA	-----MAEEGGSPSAVEGVSGYLLKIHSSLTVTDTKSAIEISNIFGNLRQ	46
CAECIL	-----MSVPGVGGDSAVGVQGSLLRRLHASLSSKDPGLEAPVAQSLIRSLGE	46
SNAKE	-----MASSL-VVP---GGGLQGFLQLHLDALRSSDASSAALRGCSSLIRSVAE	44
CANARY	-----MAGVQQCLLQLHRCLQPGDAGGSALHGYSLLRSLAE	36
OSTRICH	-----MCS-----ERKDVQA	10
GECKO	-----MAISLPVA---GGGLQGLLLQLHGTLPDPASAALHGHSIRSMAE	44
TURTLE	-----MAAALPVGG---GGGIQGSLLHQLSCALQDPDGTAAALRGYHLIRGVGE	45
ALLIGATOR	-----MAALV	5
PLATYPUS	-----MAGSVPGPQGSLLRLQRFLEAEDAGVSAVAAYQLIRGLGQ	40
TASDEVIL	-----MSGAGGGGLQGSLLQLQELLSGGDPGSAALAAYHLIRAVGQ	41
HUMAN	-----MAGSGAGVRCSSLRLQETLSAADRCGAALAGHQLIRGLGQ	40
MOUSE	-----MAEEGTGVRWLLQLQEFLSAADRCSAAGASYQLIRSLGQ	40
CRASSO2	-----MAASLLEDNLRSLNECLTTAD-NSSKEQADSIVADISQ	37
POMACEA	-----MAATLEETLRLSLHDQ---SG-ASAYNLANGLIADIRQ	33
TRICHOPLAX	-----MASNLSQLLIDLHALLNLQS-LHRGSNACDIASDITV	36
NEMATOSTELLA	-----MTDAISSRLLQLNELVAEES-PLRGQESAEIARDLRA	36
PRIAPULA	-----MARTVRIEDHVQTLLESPLSDDREADPETAHSAVADLAH	39
SOFTCORAL	-----MTEVIDRYLNQLNSCLKTLSSSRG-REAADICRDLRL	36
PISTILLATA	-----MSDLLNRYLTHLHSL-PSLDAPHCGLDASNTVVVDLGS	36
HEMICHOR	-----MPSELQSKLAELLELLDETPSQHTVEKCNNLIGEIQ	38
BELCHER	-----MAGSGSLEARLSELHALLAESDHGHGAVEAHNLVADIAQ	39
STRONG	-----MAAAELQRHLAELHEVIDSGGTAHGPEAQLVVDIAQ	38
STARFISH	-----MATADLPVKLSELNGLISTKSGLHVAEKAQDLVVDLGH	38

Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus “putative archaeon”

		RYG70452.1
ARCHAEON	IGSGDL-DELD-LDTCT ALLL APGQTASGLPGDSIKRSS SSLMQ FLTASLRMKD-----	85
MUDCRAB	HLTKDL-SPVQ-YDLFL SHV FG-----E KGI I AF GTRVTKEQA-----	76
SCORPION	ICLRGTLSEKD-RSYVC SLIL R-----K EDG FL H FL EEAV NT PS -----	76
SPONGE	LCVEQI-TESE-LAYSS SVL FN-----P DNG IL K FL H DVTT LEE -----	69
CAPITELLA	ICLNDV-NASD-VDLAY SVIF N-----H ETG L I K FL K K I Q N DE-----	74
DANIO	ECMITK-NENE-LVLQT SLLF A-----K EEG LL S FL RR SL ST E K L G TT G V	86
MILII	DFRCSSSSDSQ-LALQS SMV FS-----K DTG LL V FL R K S L R F EE -----	81
BAMBOO	DLNH-NTHESR-LALHS SLV FS-----K DEG LL I FL R K S L S N EE -----	85
XENOPUS	ECLV S ALGSSA-LDLNT SLIF S-----K EFG LL A FL V R K S L SS DE -----	97
STERLET	ECM V SK-NENE-LVLQT SLIF S-----K ENGL L A FL V R K SL N IED-----	83
GAR	ECL V VR-NENE-LVLRS SLIF S-----K EDG LL S FL R K S L S SE D -----	77
LATIMERIA	ECL V TS-DENE-LALHI SLIF S-----K EIG LL I FL R K S L S SE E -----	83
CAECIL	EC V TSS-GDSV-LALQT SLIF S-----K EHG LL A FL I H K SL G IE E -----	83
SNAKE	SC V TSS-GDDI-LALQI SLV FS-----K ENGL LL S FL I Y K S L SV ED -----	81
CANARY	TCLASL-ASGE-QALHL SLV FS-----Q EYGL LL V FL I H R SL T IE E -----	73
OSTRICH	DC V F---ALP-AALHI SLV FS-----Q EYGL LL V FL I H K SL G IE E -----	44
GECKO	TC V TSS-GDVA-RALQT SLV FS-----K EDG LL A FL I H K SL S T EE -----	81
TURTLE	AC V TST-GDGA-RALQT SLV FS-----K DNG LL V FL V R K S L SM EE -----	82
ALLIGATOR	P V VIRT-GDSA-QALQS SLV FS-----K DQGL LL V FL I R K S L S I EE-----	42
PLATYPUS	EC V LSA-GPAV-QALHT SLV FS-----K EFG LP V FL I R K SL D IE E -----	77
TASDEVIL	EG V LCT-SPAV-LALQT SLIF S-----K EFG LL V FL I RES L S I EE-----	78
HUMAN	ECV LSS-SPAV-LALQT SLV FS-----R DFG LL V FL V R K SL N S I E-----	77
MOUSE	EC V LST-SSAV-QALQI SLV FS-----R DFG LL V FL I R K S L S I ED-----	77
CRASSO2	IC I NES-TDKD-IDLCC SVL FD-----K RKG LV S FL S ET V T K EE-----	74
POMACEA	IC L HEI-SEKD-RDYCC SAL FD-----K DIG I I AF L Q V A A K D E-----	70
TRICHOPLAX	L C LQTA-SDAE-KAYCS SAL FG-----Q DYGV V T FL R K S IG L DD-----	73
NEMATOSTELLA	H C SQ L R-DESELGARC S IL FD -----D KTG I I RF L H K T I A N Q E -----	74
PRIAPULA	K C LQDI-SKRD-VDLT CSV LF S -----E D R G V L I F L R R A I P L D E-----	76
SOFTCORAL	Y C IENI-NETQ-LAYCS SLLF N-----Q DDG L I T F V K AV V Q L D E -----	73
PISTILLATA	F C LE N V-SSSE-QAYYS SLLF S-----G ET S I V S FL R K V I T L D E-----	73
HEMICHOR	IC L R T T-SENE-LAY HC SV V F H -----K ETG IL L FL K K T I T I D Q-----	75
BELCHER	IC L R H T-AERD-VAYCC SVL F Q -----E STG I T A F L R K T V T L D Q-----	76
STRONG	L C L N Q T -RENE-LAFCR S EL F Q-----K ETG I I T F L Q K A V S K D E-----	75
STARFISH	L C L R Q L -SENE-LAYCC SQ L FN -----K DNG I L V FL N K A I P K D E -----	75

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus “putative archaeon”

		RYG70452.1
ARCHAEON	RDIVRAKVHAVKFLAVYVKQIKYVM----IYAEKLAIDL IQLFKMEDSSEVKAALLLPV	141
MUDCRAB	--FVDVRNSTLDLIIITL LMKDTKKII----KYVGDITNYTLFLYNADKSTKVCAHALEAF	130
SCORPION	--LKDSLIEALQFLNLF LINIGNKVV----QYGITV KDVVFSIFLRNQLAKVKILALSAL	130
SPONGE	--FASCKEELKLLSNFVKNL SRRVL----SHIVPITDVCVFIFMREKSAKVKNATLNLL	123
CAPITELLA	--FEGCKCEI LELLKTFISKFP GKVH----PYAVDVKDAQLQLITRDRRARVKNNATPLL	128
DANIO	EILRETRVEIMNFLGAF LQRMSATV R GWEKNYAVELKDT C I V V Y T K D K S A K C R N P A L D L L	146
MILII	--FRDSREDV LKLLSEVVERIGEAVG----RYACDIKGT CVVVYTK EKA A K C K A A A L D L L	135
BAMBOO	--FRDCREEV LKLLITAFVEKIKETV G----PYALDIKDVCLVIYTK EKA A K C K V A A L D L L	139
XENOPUS	--FKDCREEA LKFLYTFLEKIGSNVQ----PYAMDIKTL CVIVYTK DRAA K C K I P S L E L L	151
STERLET	--FRDTREEA LKLLTTF L D R I A H K V N G W E K N Y A C D I K D T C L V V Y T K D R A A K C K V S A L E L L	141
GAR	--FRDVREEV LKLLSTFLQRITQSVK G W E R N Y A V D I K E T C L V V Y T K D K A A K C R V P A L S L L	135
LATIMERIA	--FRDNREEI LKFLTAFVEKIGQKLN----PYACNVKLILFPVFFF----FIFIFTY	132
CAECIL	--FRDCREET LKFLCIFLEKIGQKVQ----PYACDIKNT CVVVYTK EKA A K C K V P A L E L L	137
SNAKE	--FRECREEA LKFLILAFVEKIGPKIQ----PYADV K R I C V T A Y T K D R S A K C G I P A L E L L	135
CANARY	--FRDCREEA LKFLCVFMEKVGDKIH----PYACNIKQTCLSVYIKERTAKCKISALELL	127
ONSTRICH	--FRDCREEA LKFLCAFLEKIGEKVH----PYACNVKQTCISVYTKERA A K C K I P A L E L L	98
GECKO	--FRECREEI LKFLCAFLEKIGEKIH----LYAHDV K R T C I V Y T K D K S A K C R I P A L E L L	135
TURTLE	--FRECREEA LKFLCAFLEKIGQQVH----PYAHDIKQTCISVYTK EKA A K C K I P A L E L L	136
ALLIGATOR	--FRDCREEA LKFLCTFLEKIGQGVH----PYACDIKQTCISVYTKDKMAKCKIPALELL	96
PLATYPUS	--FRDCREEA LKFLCIFLEKIGQKIE----PYSYDIKSV C I S V Y S K D R A A K C K I P A L E L L	131
TASDEVIL	--FRDCREEA LKFLCIFLEKIGQKIE----PYSLGIKSVCTSVYTKDKAAKCKIPALELL	132
HUMAN	--FRECREEI LKFLCIFLEKMGQKIA----PYSVEIKNTCTSVYTKDRAAKCKIPALDLL	131
MOUSE	--FRDCREEA LKFLCVFLEKIDQKVM----HYSLDIKNTCTSVYTKDRTAKCKIPALDLL	131
CRASSO2	--FQTKQKILEFLSEFVQRIGKKII----PYVFDIKDVCVSLFFRERLAKIKNLSVPVL	128
POMACEA	--FQSTKTNL LDFLIGDFLQKVGKLL----PYAIDIKEACVSAF SRDKYAKVKNSALGVL	124
TRICHOPLAX	--LDKCKEDL LKLLITAYMEKIGGKIS----PYAVQIKDVCISLFTRDKAARVKNATFPPL	127
NEMATOSTELLA	--FVECKTEL LKFLQSYLGQLNTRVN----PYAVAIKD I C M K L L F Q E S S K V K I E T F L P L	128
PRIAPULA	--FKLAKKEL LQLLHSFINKGQTRIL----TYAVDIKDTCLAVFSRDRQADVKNATFPPL	130
SOFTCORAL	--FAKCKEVI LSFLAEYIAKVKTRIS----PYATDIKDI CLKLFTKDKNARVKNETFEVL	127
PISTILLATA	--FQDAKIEL LKFLQSYVMKMGKIN----PYVVEIKDI CLKIFSQDHSNKAKAETLPLM	127
HEMICHOR	--YVSSKERI LEFVYNFMIRADKKIV----TYALDIKDVCLSLFTRDKMAKIKNRTFPIL	129
BELCHER	--YLPKAVET LSFL LAFLEKIGRKIQ----PHAVEVKEVCM AVFSRDRLSRVKCATFPVL	130
STRONG	--YGGSKVQT LEFLLGFVQKAKELVL----DHAKDIKDVCM SLYTRDKLAKVKAKTFPLV	129
STARFISH	--LKGSKEQL LEFLHAFLLKAGSRL----ARTVEIKKICISAFMRDKSAKVKTTFPVL	129

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus “putative archaeon”

		RYG70452.1
ARCHAEON	KNILRPRIYSVEAIDAVAKLDDADDEVDYDDCVPFDLDTFPLQSIYQVLVEEVRLNK-K	200
MUDCRAB	CLLLEKFSHSVSV-----Q-DINLHQLIEG---ICIQTQRY	162
SCORPION	IKVLELCGSAISS-----E-QFNLQKIVNKIIEYLAQASSK	165
SPONGE	INTLELCGKTEYS-----H-DLDIPKIADKFFQAALLPT-K	157
CAPITELLA	IELLKQTSGLPVA-----G-DLQVEGMIERLFKELIKSP-K	162
DANIO	IKILYLTKDSSIT-----Q-NLRIGDMFNKIFYGELCQKH-K	180
MILII	ITLLHSKLSSSCL-----Q-QFKIGELFNKIFYGELSQKS-K	169
BAMBOO	LVLHLSK---VCL-----Q-EFKIGDMFNKIFYGELAQKS-K	170
XENOPUS	IKLLQLLKNSSII-----E-EFKIGEIFNKIFYGELATKS-K	185
STERLET	IKLLHITS-PCLL-----Q-EFKVGD MFNKIFYGDLAQKS-K	174
GAR	IQLLHGTKSSGVA-----Q-DFRVGD MFNKIFYGELSQKS-R	169
LATIMERIA	LQLLQSTKSPHCI-----E-EFKVSEMFNKIFYGELAQRS-K	166
CAECIL	IKVLQILKNSYEI-----E-ELKVKEIFNKIFYSELGVKS-K	171
SNAKE	IKLLQKLQSSYAM-----V-DMKVGEIFNKIFYGEIAIKS-K	169
CANARY	IKLLHTLQRSCLM-----E-EMKVGEIFNKIFYEELAARS-R	161
OSTRICH	IKLLQNLRRSCLM-----E-EMKVGEIFNKIFYGELATRS-K	132
GECKO	IKLLQNVRSACVM-----E-DMKVGEIFNKIFYGELAVKS-K	169
TURTLE	IKLLQNLRRSSFLM-----E-ELKVGEIFNKIFYGELAARS-K	170
ALLIGATOR	IKLLQNVQCSSLM-----G-ELKVGEIFNKIFYGELAGKS-R	130
PLATYPUS	IKLLQTLRSSRLM-----E-ELKVGGI FNKIFYEELALKT-K	165
TASDEVIL	IELLKTLRSSRYM-----E-EFQLGELFSKIFYGELALKT-K	166
HUMAN	IKLLQTFRSSRLM-----D-EFKIGELFSKIFYGELALKK-K	165
MOUSE	IKLLQILRSTRM-----D-EFKIGELFNKIFYGELASKS-K	165
CRASSO2	AKVLELSVGSVNV-----Q-DLGIDKMINKFFMELTKSVSK	163
POMACEA	VKVLLELTVGSPIR-----E-EMKIDNLVEKLFRELTKTS-K	158
TRICHOPLAX	LQLLSSKLHSSVV-----E-ELAISKLVDKYMSACKOPT-K	161
NEMATOSTELLA	IQLMQTKLESSII-----D-EMDIPKLI DRYFKACLQSS-K	162
PRIAPULA	IKVLQLCRGSQTQ-----A-KLDVPKLI DRYFNELTQSS-R	164
SOFTCORAL	LQLFELKFEPTIV-----E-KLDVKNIVEKYFSACSQST-K	161
PISTILLATA	AEILDVKLESSVV-----E-KLDVPKI FDKYFGACIQPV-K	161
HEMICHOR	NKLLLELTANTPVA-----K-ELGVSKLIDKYFSQLMQPS-K	163
BELCHER	KKVLQLTIHSQLG-----D-ELRVSDMVDRMFLELTMKS-Q	164
STRONG	IELLKLTSGTRMD-----DEAMGVDAMLKFFGELGQPS-K	164
STARFISH	IELLQRSASAQME-----A-DLDIPKMIELYFEQLMQPS-K	163
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70452.1
ARCHAEON	LTGK V HREALAT L GILVAVY P AAAF T VSVIDI I LSL C DEAL K -----NAF N SRG K -DP D	253
MUDCRAB	KGST I LHHQ L R T L G VLAKVY P ENV R C--HSAM I L K IY K DH I A-----RHM G Q----K T D	210
SCORPION	ITPT V KQ Q AY L L G ISSRH Y PDC M Q L --CSER L LN W Y L KD L K-----FHT T SN--Q K S E	215
SPONGE	HSAT I RGG I Y H LL G VLCEW F PEHL V K--ISS R L I DI Y MS N L K -----SE M TV K KT K PE	209
CAPITELLA	PAAS V KAH I F H LL G VIAEL F PE K M V R--GSD K LL N LY M TT L K-----QE I ES K TH-EP E	213
DANIO	IPDT V LGC I Y E LL G VLGEV H PSEM V N--NSD K LY K AY L GE L K-----GQ M T S TT K -EP K	231
MILII	FPDT V LE K VY E LL G VLAEV Q PTE M L H --NSE K LF C AY L N E L R -----VQ M T S AT R -EP K	220
BAMBOO	LPDT V LE K VY E LL G VLAEV Q PTE M L D --NSE K LY R AY L N E L K -----IQ M T S AT R -Q P K	221
XENOPUS	LSDT V LE K VY E LL G ILGEV Q PCE M T Y --NSE K LF K AF L GE L K-----AQ M NS S TR-N P K	236
STERLET	IPDT V LE K IY E LL G VLGEV Q PS D ML N --NSE K LY R AY L SE L K-----SQ M T S AT R -EP K	225
GAR	IPDT V LGN I Y E LL G VLAEV Q PS D MT D --NSE K LY R AY L GE L K-----SQ M T S TT R -EP K	220
LATIMERIA	LPDT V LE K VY E LL G VLGEV Q PSE M L H --NSE K LF R AF L GE L K-----TQ M R S TT K -EP K	217
CAECIL	VPDT V LE K VY E LL G VLGEV Q PS D ML D --NSE K LF R AY L GE L K-----KQ M T S TT R -EP K	222
SNAKE	VPDT V LE K IY E LL G VLGEV Q PSE M ID--NSE K LF R AY L LE L K-----VQ M T S AT R -Q T K	220
CANARY	IPDT V LE K IY E LL G VLGEV Q PS D MI N --NSE K LF R AY L RE L K-----TQ M T S AT R -G P K	212
OSTRICH	VPDT V LE K IY E LL G VLGEV Q PS D MI N --NSE K LF R AY L GE L K-----TQ M T S TT R -V P K	183
GECKO	VPDT V LE R IY E LL G VLGEV Q PS D ML E --NSE K LF R AY L GE L K-----TQ M T S STR-EP K	220
TURTLE	VPDT V LE K LY E LL G VLGEV Q PS D M V D--NSE K LF R AF L GE L K-----TQ M T S AT R -EP K	221
ALLIGATOR	VPDT V LE K IY E LL G VLGEV Q PS D ML D --NSE K LF R AY L GE L K-----TQ M T S AT R -EP K	181
PLATYPUS	ITDT V LE K IY E LL G VLGEV H PSE M LC--NSE K LF R AY L GE L K-----MQ M T S STR-EP K	216
TASDEVIL	IADT V LE K IY E LL G VLGEV H PS V M V H--NSE K LF R AF L GE L K-----TQ M T S TT R -EP K	217
HUMAN	IPDTVLEKVYELLGLLGEVHPSEMIN--NAENLFRAFLGELK-----TQMTSAVR-EPK	216
MOUSE	LPDT V LE K VY E LL G VLGEV H PSE M IN--H S E N LF R AF L GE L K-----TQ M T S TV R -EP K	216
CRASSO2	LPAS V KE S IY V IL G LLAE I Y P EH M T Q --YAG K L V DI Y LR A L K -----A E M T S K T K -K P E	214
POMACEA	LVPT V KG N IY F LL G VIAEV Y PED I T Q --D S DR L V G LY V S A L K -----A E M T S K T K -K P E	209
TRICHOPLAX	YSST V KSG M Y S LL G TIAEK F PE Y IMP--HA Q Q L L T IY L N T L K -----SQ M T G K N T-K L D	212
NEMATOSTELLA	QQST V RF W LY T IL G VFAEV F PE H ML G --N A DR L I S IY I N L L N -----SE M K S K G N K SP D	214
PRIAPULA	LTST V KQ G VY H LL G VIAES Y PE L M V A--Y A D K L I S I Y V N E L K -----N Q M K S K T K -K P E	215
SOFTCORAL	KKSS V SY G IY S LL G T L AEY F PE Y M V D--K A DR L V Q IY V G V L K -----A E -M R K S G-K P D	211
PISTILLATA	HSST V KY W LF S LL G TIAK V PE C V I S--H S D H L V K H Y V S V L K LEN L I P M Q M T R K T K -K P D	218
HEMICHOR	LAAT V K H G I Y H LL G VFAQ Y Y P EL M T K --Y S DR L LN V Y M K A L K -----D Q ML S K T K-Q A E	214
BELCHER	TTAT V K S G A LS L G V ISEV Y P D LM V Q K D H PD R LL K VY I S M L K -----E Q M E S R TR-K P E	217
STRONG	LSQS V K L G I Y Q T L G A F G EY Y P Q L M M H --Y S DR L FN V LV S T L K-----Q Q M T T K T K -K P E	215
STARFISH	LSQT V K Q G I Y C LL G VLA E IY P VL M S G --Y S ER L LS V Y I AT L N-----Q Q M T S K TR-K P E	214
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70452.1
ARCHAEON	FP AI AG F SC L DK C LY H FE A RYV----NSTEL W KY L LQ A AQ S SA--QEDTSR F SA A G K AI	307
MUDCRAB	LI A LAG V LR G LT L Y L FN F PEGIDDDPL L Y K TL F EH V R K AL N PN L ----DLHRRDAQ R A A L	266
SCORPION	SS I IV G CL Q GL N EF M Y Q FL Q DT E DE T E K AY Q L F K F IR I IL S KR-----DV K TY D MA K AS L	270
SPONGE	LP I IS G CL Y GL T AY L NN F S Q S A SE G S V YA Q DI Y K Y TR M AID P LA----NLTRYEV P RA G L	265
CAPITELLA	Y V LI A GC L Q G L T H F M V N F T Q SA D E G A E H A YS I Y K Y C V K T M D Q NI----K K K R Y E M P K A S L	269
DANIO	LP V V A GC L K G IA A LM V N F T K S V E E D P A A S K E I F D Y A L K A I S P Q T ----D I K R Y A V I F A G L	287
MILII	FL V VS G CL R GL T AL M IN F T K S M E E D P K A S K DI F D Y A L K A IN P Q I ----D L K R Y A V P LA G L	276
BAMBOO	FL V VS G CL R GL I AL M VN F T K S I E E D P R T S K E I F D CA V KA I N L K I ----D I K R Y A V P LA G L	277
XENOPUS	FP V I A GC L K G L S AL M IN F T K T M E E D P R T S K E I F D Y T V K A I S P Q V ----E M K R Y A V P S A G L	292
STERLET	LP V V A GC L K G L T AL M IN F T K S M D E D P K S S K E I F D F A L K A I S P Q T ----E F K R Y A V L LA G L	281
GAR	L P L V V A GC L K G L T AL L VN F T K S M S E D P K T S K E I F D Y A L K S I S P Q T ----E F K R Y A V L F A G L	276
LATIMERIA	LS V V A GC L R G L T AL M IN F T K S V D E D P K T S K E I F D Y A V M A I S P Q V ----D L K R Y A V P LA G L	273
CAECIL	LS V V A GC L K G L T SL M IN F T K S M D E D P K V S K E I F D Y S V K A I S P Q V ----E L K R Y A V P LA G L	278
SNAKE	FP I V A GC L K G L T AL M YN F T K S M D E D P R T S K E I F D FA V KA I S P K I ----D L K R Y A V P LA G L	276
CANARY	L P L V V A GC L R G L M YN F T K S V D E D P Q T A K E I F D FA M KA I N P Q V ----D Q K R Y A V P LA G L	268
OSTRICH	LP I V A GC L R G LA L M Y N F T K S E D E D P Q T A K E I F D FA M KA I R P Q I ----D Q K R Y A V Q LA G L	239
GECKO	FP V V A GC L K G L T AL M YN F T K S M D E D P Q T S K E I F D FA V KA I N P Q V ----D L K R Y A V P LA G L	276
TURTLE	LP V V A GC L K G L T AL M YN F T K S M D E D P H T S K E I F D FA V KA I N P Q V ----D L K R Y A V P LA G L	277
ALLIGATOR	LP V V A GC L K G L T AL L Y N F T K S M E E D P R T S K E V F D F S V KA I N P Q V ----D L K R Y A V P LA G L	237
PLATYPUS	LP V V A GC L K G L S AL M C N F T K S M D E D P Q T S K E I F D F A V KA I S P Q V ----D L K R Y A V P LA G L	272
TASDEVIL	LP V V A GC L K G L S SL M YN F T K S M D E D P Q M S K E I F D F A L K A I S P Q V ----D L K R Y A V P LA G L	273
HUMAN	LPVLAGCLKGLSSLLCNFTKSMEEDPQTSREIFNFVLKAIRPQI----DLKRYAVPSAGL	272
MOUSE	FP V LAG L K G L S SL L C N F T K S M E E D P Q T S K E I F G F T F KA I R P Q I ----E M K R Y A V P LA G L	272
CRASSO2	LS V IS G CL E GL A S L VN F T E D--ED S Q N S Y E T F K F A R M AID P DI----N Y TR Y D V P R A G L	268
POMACEA	FP V I V GC L Q G L T AY L VN F T Q SS D E G SS H S Y E I F N Y A R M AID H K V ----E F S K Y D V P K A G L	265
TRICHOPLAX	MP V I Y GC L R G L T S Y L Y N F T Q S V E E S K Y A DI Y K Y AR L AID P K V ----E L P R Y D L P K A G L	268
NEMATOSTELLA	K Q V I AG L K G L S S Y L V N F T Q S A A E G S K F A R DI Y E F TR M AID V Q G ----T L Q R Y D V P RA G L	270
PRIAPULA	Y P V I T G CL R GL T C Y L N T F S Q S A D E G S G Y A R D V Y D C V M R CT G Q H L---S E I R R Y D V A K S A L	272
SOFTCORAL	MP V V A GC I R G L D ST L VN F T Q S V N E G S I Y A K NI Y S F L R S A ID S K I ----N Y A R Y D V P RA G L	267
PISTILLATA	ML I I A GC L R G L T S Y L T N F T Q S V S E G S K F A K DI Y T Y G R M A IN P Q V ----S L S R Y E V P K A G L	274
HEMICHOR	LP V V A GC L L G L T H L L V N F T Q S V E E D G K H T L DI Y K F AS L AM D P S T----Q L L R Y G V P E A G L	270
BELCHER	ML V IS G CL E GL T H F L V N F T Q S V E E G S A H S K DI Y N F TR R A V S P Q V ----E M A R Y D V P K A A L	273
STRONG	MT V V A GC L M G L S H L L V N F T Q S V E E NS K H C K D I Y Q Y V T M S V D P G P Y R S G T K P R Y E I P K A G L	275
STARFISH	LT V I A GC L T G L G H Y L V N F T Q S V E E G A K H S K DI Y R F A R M A ID P T V ----D H TR Y E L N K A G L	270

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus “putative archaeon”

	End RYG70452.1	Start RYG70451.1 (Archaeon)	
ARCHAEON	KLIRNHAQLFVNVIGELVHSTLYAMNAQTSYGVVAAAHKSGKVALYKHSEGALQAVLAAA	367	
MUDCRAB	ELISSHGDKFSAQLYDHYD-----TLFPWFIQWCSSKNRDDYKAAIPALDTFITVL	317	
SCORPION	TLLSSHASLLAQFLYEDSM-----NIYKIIIEIWTNHSNREVRSLGYNALDAVFKQI	321	
SPONGE	SLISRHAQFREYLVKDSE-----HMYESLSSWSNHKNKECRVVAVNAIGSFREV	316	
CAPITELLA	GLMAKHSQAQMSDYLLDDFK-----DLYETLSYWTNHNREMAHIGMLALEDFLVQI	320	
DANIO	KLFAKHSQFGSCLMDHYI-----SIFDVMKSKHCGHINAEKKSYSYTALESFLKQV	338	
MILII	RLFTLHSQFGTCLMDNYR-----TVFEKMKKSCGHTNSEMKKASYSALESFLKQV	327	
BAMBOO	RLFTLHANQFKTCLLDNYR-----VLFETMSKWCGHTNIEMKKAGYAALLESFLKEI	328	
XENOPUS	NLLALHASQFSSYLMDDYQ-----SLFEVISKWCGHTNGEMKKLAFALDSFLKQI	343	
STERLET	RLFAKHAGQFSSCLMDNYR-----SLYEVMSKWCGHTNIEMKKAGYHALEAFKQV	332	
GAR	KLFARHAEQFSSCLIDNYR-----SIFEVMSKWCGHTNAELKRAGHSALLESFLKQV	327	
LATIMERIA	RMFALHANQFNTCLMDNYR-----SLFETMSKCCGHANGELKRAGYAALLENFLKQV	324	
CAECIL	HMLAIHASQFGSCLMDNYR-----SLYEVMSKWCGHTNADLKKAGHLALESFLKQI	329	
SNAKE	HLFSKHAEQFSTCLLDNYV-----SLFHTMAKWCGHQNAELKKAGHSALDSFLKQV	327	
CANARY	QLFIWHSQAQFGALLLDNYV-----SLYEVMSKWCGHTHPELKKASYSALDSFLKQI	319	
OSTRICH	QLFGRHAAQFGTFLLDYSV-----SLFETMCKWCGHTNQELKKAGHSALDSFLKQI	290	
GECKO	HLFSVHAVQFSTCLLDNYV-----SLFEVMSKWCGHQNAELRKVNSALDAFLKQV	327	
TURTLE	HLFSMHAAQFGTFLLDNYI-----SLFEVLSKWCGHTNAELKKGGHSALDSFLRQI	328	
ALLIGATOR	RMFGLHAAQFGTCLLDNYV-----MLFEVMSKWCGHTNVDLKKAGHSALDSVLKQI	288	
PLATYPUS	HLFTVHASQFGTNLLDNYV-----YLFVEMAKWCGHTNGELKKVAHSALDSFLKQI	323	
TASDEVIL	RLFTLHASQFSTCLLDNYI-----SLFEIMSKWCGHTNGELKKIAHSALDSFLKQV	324	
HUMAN	RLFALHASQFSTCLLDNYV-----SLFEVLLKWAHTNVELKKAALSALLESFLKQV	323	
MOUSE	RLLTLHASQFTACLLDNYI-----TLFEVLSKWCSTNVELKKAHSALLESFLRQI	323	
CRASSO2	KLFSRHSQAQFKSQLADDYQ-----GMYQKLSWSKHNNRELLHLGTAAMEAFLTQI	319	
POMACEA	QLFARHAGQFSQFLVDDYE-----NMYTKLQAWSKHQNRDVLHHGVAAMD AFLRQI	316	
TRICHOPLAX	NLIAKHAAQFCDYISREAE-----ALYEVIYRWRHRNRDIRAAAFHAALEEIMKQI	319	
NEMATOSTELLA	NLLSRHAGQFQEYICTEHNVS-----IVYPAIYRWCCQNRETKYAALDAMD SFKQV	324	
PRIAPULA	WLLAKHAAQLDRFLLADYK-----AVYSCLRSWSRHHNRDVQIAGYAALAEAVLKQI	323	
SOFTCORAL	NFLARHASQYKEYLTKDYE-----SVYNTLFDWCKRKNKELRVKGFAALEAFKQV	318	
PISTILLATA	YLFKHSQAQFKEYIAKDYE-----VMYGDLYRWCKHHNKETSAYAAMEAFFQOI	325	
HEMICHOR	WLLAKHAPQFNKYLLDDHE-----EMYDKLFSWCQHNNRDMKSAGYASLEAFKQV	321	
BELCHER	WLLAKHAAQFNEYLLMNDYE-----DMYRKL YEWSQHPNRDLKQAGYAALLESFLKQI	324	
STRONG	NLIRRHADQFNEYLYRDHE-----MVYNRLKYWSHSHNSEMKWAGYDALQAFFKVV	326	
STARFISH	NMFAKHSQAQFGPYLYSDHQ-----DLHEAFNKWSAHNNPAVKAVGFAAQEAFLQOI	321	
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus “putative archaeon”

		RYG70451.1
ARCHAEON	ASYLVQNMHTGSNAVKKKTCDMVNKLLLEAHLKVLQDPGTLRSNSDDTVV ALQGLNALSLAV	427
MUDCRAB	SNILELQSSD--KK--TVEIFKYL LLQ EYNK ML ET----GKSTNQVSL AVKGYGLLSG --	367
SCORPION	SDMLEQNYEDS---C--KAEIFK FIEK FQ LM IKC----SENIRRVST AIRGFYFAK --	370
SPONGE	STQISDPSISR--EL--GISNYK FFMKCFRSL MNDP---DINHRLLSI AVKGYGHFAK --	367
CAPITELLA	SSALVTKVKEG--NRK--EGAVFK FFIQKFRD IMDNN---SSGSKEIAI AIKGYGYFAA --	372
DANIO	ATLVAENIELH-----KSKLK FFMQKFC AI IRT M---DSTNKELSI AIRGYGLFAA --	386
MILII	AIQVAENAHLH-----KDKLEY IMQQFY DI IRT P---ESSMKELSI AIRGYGLFAA --	375
BAMBOO	ALQVAEDAHLH-----KDKLQ YFMQQFY SI IRT M---ESSTKELSI AIRGYGLFAA --	376
XENOPUS	AHLVASDAETH-----KNKLH FFMEQFY EI IRK M---DSSNKELSI AIRGYGLFAA --	391
STERLET	ALLVAENAELH-----KSKLE FFMRQFY T VRT L---DSSTKELSI AIRGYGLFAA --	380
GAR	AVLVAENAELH-----KSKLK FFMQQFC SI IKT T---DSTNKELSI AIRGYGLFAA --	375
LATIMERIA	AAMVAENAELH-----KNKLEY FMKQFY GI IRT L---DSSNKELSI AIRGYGLFAA --	372
CAECIL	ASIVTHDAETH-----KSKLQ FMQFY RI IRK L---DSSNKELSI AIRGYGLFAA --	377
SNAKE	SSMVAKDVEMH-----KSKLR FFMEFY GI IRN M---DASNKELSI AIRGYGLFAA --	375
CANARY	SLMVAKDAELH-----KSKLR FFMEQFY GT IRR M---DSSSKELSI AIRGYGLFAS --	367
OSTRICH	SLMVAKDAELH-----KSKLQ FMQFY GI IRR M---DSSNRELSI AIHGYGLFAA --	338
GECKO	SEMVAKDAEMH-----KSKLNY FMKQFY SI IRK M---DSSNKELSI AIRGYGLFAA --	375
TURTLE	SLMVAKDAEMH-----KSKLQ FMKQFY DI IRK M---DSSNKELSI AIRGYGLFAA --	376
ALLIGATOR	SLMVAKDAEMH-----KSKLK FFMEQFY SI IRK M---DSSNKELSI AIRGYGLFAA --	336
PLATYPUS	SLMVAKDVELH-----RSKLQ YFMQFY EI IRK I---DSTNKELSI AIRGYGLFAA --	371
TASDEVIL	SLMVAKDAEAH-----TSTLRY FTEQFY GI IRN V---DSSSKELSI AIRGYGMFAG --	372
HUMAN	SNMVAKNAEMH-----KNKLQYFMQFYGIIRNV---DSNNKELSIAIRGYGLFAG--	371
MOUSE	SFTVAEDAELH-----KSRLKY FMEQFY GI IRN T---DSNNKELAI AIRGYGLFAG --	371
CRASSO2	SEVLVTKAREG--KK--EAAMFK FFVTRFKE IMENS---SASAKEMSL AIRGYGLLAA --	370
POMACEA	AEAIT TEK AKRG--IK--EGGIFK FFVQVFQTTM QNS---SASSKEVSM AVRGYGLFAA --	367
TRICHOPLAX	AEYLVNEND---AA--NINIFK FFLKKFR SI ID SG---SSDAKELAI AIRGYGYFAA --	368
NEMATOSTELLA	SEYIVLDEA-----E--AVNPKED FIQRFRAI ID SD---SSTTQQMSI AIRGYGFFAK --	372
PRIAPULA	ASVLVEGGEET-RQR--DTIV FTFVRE FRTI IEA ---GTDTRDVAI AVRGYGSFAT --	374
SOFTCORAL	AECLVTEDFET-TVE--CGDIFK FFIKEFRRI INS N---ESLTREISI AIRGYGYFAK --	370
PISTILLATA	SLYFVGRHG---DKS--DLAMF YFIKTFRRI ID SV---LSDTRQMAI AVRGYGYFSK --	375
HEMICHOR	ASMLVEEGNKD-KRN--KTTIFK AFIRKFRSI ID NR---ESGTREICI AIKGYGLFAA --	373
BELCHER	SDMLVARHEKENKA--DLAVFK FFIRE FRTI ID TT---EAGTREMSI AVRGYGFFAA --	377
STRONG	SHMLVENADKK-RSS--DVAVLK YFIKFRST ID DA---SSSSKSLST AIRGYGVFAA --	378
STARFISH	AEILVERAAKR-DAS--DMAVFR FFVKFRDI ID NP---QSDTRALSS AVRGYGYFAA --	373
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70451.1
ARCHAEON	SPAPLGGQYAFQLNYCCADVIRTVVEIGDHYNRYQRSSKGDSEANGEGTAGNNQSAF	487
MUDCRAB	-ACRIL-----LSPMEVHTMFLQV-----	385
SCORPION	-VCKLY-----LTEKDVKYMLNDV-----	388
SPONGE	-PCRLY-----GSMEDLHFMTGEM-----	385
CAPITELLA	-PCKLY-----LTPKDVLFMFNEM-----	390
DANIO	-PCKVV-----CPQDVDFMYTEL-----	403
MILII	-PCKAV-----NSNDVDFMYIEL-----	392
BAMBOO	-PCKAV-----DSHVDVDFMYTEL-----	393
XENOPUS	-PCKAV-----NAKNVDLMYIEL-----	408
STERLET	-PCKAV-----CLGDVDFMYTEL-----	397
GAR	-PCKAV-----CPQDVDFMYTEL-----	392
LATIMERIA	-PCKAV-----CPEDVDLMYTEL-----	389
CAECIL	-PCKVI-----NAKDVDFMYIEL-----	394
SNAKE	-PCKVI-----NPKDVDFMYVEL-----	392
CANARY	-PCKAI-----HPEDVDNMYVEL-----	384
OSTRICH	-PCKAI-----RSKDVDFMYVEL-----	355
GECKO	-PCKAI-----NSKDVDFMYVEL-----	392
TURTLE	-PCKAI-----NSKDVDFMYVEL-----	393
ALLIGATOR	-PCKAI-----NSKVDVIMYIEL-----	353
PLATYPUS	-PCKVI-----NPNDVDIMYIEL-----	388
TASDEVIL	-PCKSI-----NAKDVDFMYIEL-----	389
HUMAN	-PCKVI-----NAKDVDFMYVEL-----	388
MOUSE	-PCKVI-----NAKDVDFMYVEL-----	388
CRASSO2	-PCREF-----LQKDVQFMFSEM-----	388
POMACEA	-PCSIF-----LEPADVTFMFSEM-----	385
TRICHOPLAX	-PCKTL-----LKKDVRFMFMDL-----	386
NEMATOSTELLA	-PCKLF-----MTAEDVKFMFTEM-----	390
PRIAPULA	-PCKLF-----LSEADVQYMFTDM-----	392
SOFTCORAL	-PCKVF-----LKDEDIKYMFTSI-----	388
PISTILLATA	-PCKLF-----MQADDVRFMFSEI-----	393
HEMICHOR	-PCKLF-----LSEDDVKFMFNEM-----	391
BELCHER	-PCKMF-----LSESDVKFMFSEM-----	395
STRONG	-PCKAF-----MKEADVRFMFNEI-----	396
STARFISH	-PCKLF-----MTDDDVKFMFTEM-----	391
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70451.1
ARCHAEON	LVYCKSLFFCVVV-----SYLFNATVHCLSGTGQGGKLVVLENTASDQRLVQFLEELGVE	542
MUDCRAB	LSASHHAFYQSS-----EMLNKLNSLPSYIEALADI ICNMSTINVGIVENMLQLALA	438
SCORPION	IKKSEQHCLNEE-----KILDERIQILPSFLDSLSSIVLQLQEISESSLNYLEKLAVF	441
SPONGE	VQRSEQLFLASVDFTTSSSSVAFEEERFLPTFIEALANISKEIQNLPDVCLSSLQKLSVL	445
CAPITELLA	LHRSEQLFLSGA-----EQNDDRIIGLHSFLGALASIVEELDQFSETFLFSLERLVVL	443
DANIO	IQRCKQMYLTES-----DRDDDNVYQLPSFLDSIASVLVHLDRIPEVYTPVLERLLVV	456
MILII	IQRCKQMYLTEA-----DTEDDNVYQLPSFLDSIASVIFHLDKIPGVYTPVLERLLVV	445
BAMBOO	IQRCKQMYLTEA-----DTEDDNVYQLPSFLDSIASVIFHMDKIPDIYTSVLERLLVV	446
XENOPUS	IQRCKQMYLTEA-----DTEEDNVYQLPNFLQSVASVILHMDSIPEVYTPILERLLVV	461
STERLET	IQRCKQMYLTET-----DTEDDNVYQLPSFLDSIASVIFHLDRIPEVYTPVLERLLVV	450
GAR	IQRCKQMYLTET-----DTEDDNVYQLPSFLDSIASVLFHLDRIPEVYTPVLERLLVV	445
LATIMERIA	IQRCKQMYLTET-----DTEDDNVYQLPSFLQSIASVLFHIDRIPEVYTPVLERLLVV	442
CAECIL	IQRCKQMYLTEA-----ETEDDNMYQLPHFLQSIASVIVHMDSIPEVYTPVLERLLVV	447
SNAKE	LQRCKQMYLTEA-----ETIDDHVYQLPSFLQSIASVIFHLDTIPEIYTPVLERLMIV	445
CANARY	LQRCKQMFLTEA-----ETIDDHLYQLPSFLQSIASVIFHIDKVPEVYTPVLEHLVVL	437
OSTRICH	LQRCKQMYLTEA-----ETVDDHIYQLPSFLQSIASVIFHLDTIPEVYTPVLERLVVV	408
GECKO	LQRCKQMYLTEA-----ETMDDHVYQLPSFLQSIASVIFHLDTIPEVYSPVLERLIVV	445
TURTLE	LQRCKQMFLTEA-----ETADEHVYQLPSFLQSIASVIFHIDTIPEVYTPVLERLIVV	446
ALLIGATOR	LQRCKQMYLTEA-----ETADDNVYQLPSCLQSIASVIFHLDTLPEVYTPVLEHLIVM	406
PLATYPUS	IQRCKQMFLTEA-----ETIDHHLFQLPSFLQSIASVLLHLDKVPEVYTPVLERLLVV	441
TASDEVIL	IQRCKQMFLTET-----DTIDDHMYQLPSFLQSIASILLHLDTVPEVYTPVLERLIVV	442
HUMAN	IQRCKQMFLTQT-----DTGDDRVIYQMPNFLQSVASVLLYLDTVPEVYTPVLEHLVVM	441
MOUSE	IQRCKQMFLTHA-----DASEDHVYQMPNFLQSIASVLLYLDTVPEVYTPVLEHLMVV	441
CRASSO2	ITKSEQLYLSSDK-----EDIEDKLYSLPSYLEALGNI IRQLDHPETYATSIERLMII	442
POMACEA	ITKCEQEFLRTN-----EPVHEKLSLPDYLHALASI IKVVTKVSEVYALTLERLVL	438
TRICHOPLAX	LQRSEQLFFID-----VNVDKIQYLPFLEAFASILNILDEVNDTFTRSLEKLTIV	437
NEMATOSTELLA	MQRSEQIYLRQS-----EMQEDRVQQLPNFLEALSFI IEELDDISDGFLVSLERLIIV	443
PRIAPULA	VVRSRQIFHSGE-----EMIDSRMVELPPLLEALASIVTELDQVSESFLASLEQLVVL	445
SOFTCORAL	IQMSEQMYFNDS-----ELKEEKLQNLPSFLEALGFI VEEIDEIPPAFLSFLERLVVV	441
PISTILLATA	MQRSEQFYLSQS-----DLSEDRAQHLPTFLEALSSI IEELDKISDSVLACMERIVRV	446
HEMICHOR	IQRSEQLYFSQN-----ELVDETI PHLPFLEALACIVRELDVSDTFLSSLETMTVI	444
BELCHER	MQRSEQLYFGTA-----DSMEDKVHHLPSFLEALASIVQHLDQLSDMFVTSLERLVVV	448
STRONG	ILRSEQQLVQGG-----E---ERLSQLPTYLEALASIVGQLDTVSDTFLTSLEKLVVL	446
STARFISH	IQRSEQLYLQGG-----EVSDDKLNQLPNFLEALASIMRQLDVLSDSFQAALERLVVV	444
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70451.1
ARCHAEON	VIVGYTKMYSKQQ--RFTRT AMVKLF IMHTLLGNRSDLTRKKHIADLYVTLTSLLDLAF L	600
MUDCRAB	LVENFPSVSVYKT--FLAYR ALFKLF YAIHGKAEYF-----QDFIHS FVYKSVI	485
SCORPION	QIQNFPYLPSPYH--FLCY NSLIKLF LAVHSGKQPQF-----KGFLNK I IYQGI	488
SPONGE	LFHCYPFLSSHVR--YQGS VSLKLI MAVSSIPTSF-----KQFLSH IVYQGVI	492
CAPITELLA	QMQVLPRLHVKLH--NQCY IALIRLFL LGLALKGSIF-----KGFLER I IYQSLI	490
DANIO	QMDSFPQYSQRMQ--HATCR SIVKVF VAMAVRGPVL-----WSFTSS VVHQGLI	503
MILII	QIDSFPLYARMQ--PICCR SIVKVF VALAGKGPVL-----WNFIST VVHQGLI	492
BAMBOO	QIDSFPLYSVRMQ--PVCCH SIKLF IALAGKGPVL-----WSFIST VVHQGLI	493
XENOPUS	QIDSFQYSLKMQ--SSCCK AVLKVFL SLAGKGPVL-----WSLIST VVHQGLI	508
STERLET	QIDSFQYSQRMQ--PVCCR SILKVFI ALAGKGPVL-----WSFIST VVHQGLI	497
GAR	QIDSFQYSQRMQ--PACCR AIKVF VAMAGKGPAL-----WSFIST VVHQGVI	492
LATIMERIA	QIDSFQYSQKMQ--PTCC KSIVKV LALAGKGPVL-----WSFIST VVHQGLI	489
CAECIL	QIDSFQYSVKMQ--SVCCR SIVKVF LALAGKGPVL-----WNFIST VVHQGLI	494
SNAKE	QIDSFQYSARMQ--TACCR SIVKVFL LALAAKGPVL-----WSFMST VVHQGLI	492
CANARY	QINSFPQYTEKMQ--PVCCH SIKVF LSLSGKGPVL-----WSFIST VVHQGLI	484
OSTRICH	QIDTFPQYSEKMQ--SVCCR SIVKVFL ALTGKGPIL-----WSFIST VVHQGLI	455
GECKO	QIDSFQYSIKMQ--STCHK SIVKVFL ALASKGPVL-----WSIMST VVHQGLI	492
TURTLE	QIDSFQYSVKMQ--SACCK SIVKVFL ALAGKGPVL-----WSFIST VVHQGLV	493
ALLIGATOR	QIDSFPRYSEKMQ--PVCCR SIVKVFL ALAGKGPVL-----WNFIST VVHQGLI	453
PLATYPUS	QIDSFQYSIKMQ--SACCK AIKVF LALAGKGPVL-----WNFIST VVHQGLI	488
TASDEVIL	QIDNFPQYSIKMQ--TICC RAIKVF LALAEKGPIL-----WNFIST VVHQGLI	489
HUMAN	QIDSFQYSPKMQ--LVCCR AIKVF LALAAKGPVL----- RNCIST VVHQGLI	488
MOUSE	QIDSFQYSPKMQ--LVCC KAIKLF LALSEKGPVH-----WNCISA VVHQGLI	488
CRASSO2	LAENFPTIHQKQH--FFSV KSLWVL LITLMPKGEVF-----SQVLSG FVFQMLI	489
POMACEA	LLENIPTIYRGFH--FTCL KGILHLL IVLQSKGSTF-----NKVLSG FVYQGLI	485
TRICHOPLAX	LFENFPYVINELH--SLCY KSLFELL LALHSGGAAL-----KNFLSR VVYQGLI	484
NEMATOSTELLA	LFESFPRLSKSAK--YLCH KALVKML INISAKGSVL-----KNFLSE VVYQGLI	490
PRIAPULA	LFGNVPLLRRESRLDHRAC AVRVL LALRSKRATQ-----RSLVKR VVFQGLL	494
SOFTCORAL	LIEKFPELGRGPQ--FICL KAMLKLF LALTTRGASL-----KSFLSE IVYQGLI	488
PISTILLATA	LFDKFAILNKGGK--FLCK ALIRVL FHLSSKGAIL-----RNFLSE IVYQGLI	493
HEMICHOR	LMENFPRFGKALH--YTCY KSITAVL VALSPKGATL-----RNFVSR IVYQGLI	491
BELCHER	LFENFPRLGKMH--LICQ KAILKVL LALVPKGATL-----RTFLSR IVYQALI	495
STRONG	VFGSYPHQARSSQ--WTSH SAILQILL IALSAGTSL-----QGFLSR VVYQWIL	493
STARFISH	QVSSYPRVPNKYQ--YLSH QAILLVL IALSSKGATL-----KNFLSR VVYQALV	491

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus “putative archaeon”

		RYG70451.1
ARCHAEON	RTLARKESTD-----HIAADHARLSSYSVFSVEEDRLVVFVYSSLWHALL	644
MUDCRAB	HTCSHAPEIDSLKKESELW-KESNDSEESGGKWEFGKKE-----AVTYKNYLPWKAIM	538
SCORPION	RTCSYPVRFIEIAREENMS-----GDNLELKNPR-----EITSKSYSSLWENLL	532
SPONGE	RSCSLPVVIEAVQGDSDAVVT-----AAPLADSNK-----VMSYLDYVQLWIQLI	538
CAPITELLA	RCSHPVIVLESQEAKSEN-----VDEVNLKV-----DVSYQDYLPWKALL	531
DANIO	RVCSKPVQLQSDERGVSSGV-----SQSEDSTLVRSGKWK-----VPSSKDYLELFKGLL	552
MILII	RVCSKPVLLPGEETGRSES--GL-QQQSASEVMWTGKWR-----VPSYKDYLDLFRSLL	543
BAMBOO	RVCSKPVLLPGEEMTKAEPWSSA-QQSLNNGMGTGKWR-----VPSYKDYLELFRSLL	546
XENOPUS	RVCSKPVVLAQDG--KEGSEAE---TAAATGEVRAGKWK-----VPTYKDYLDLFRNLL	557
STERLET	RVCSKPVVLTGEEGG---QGGG---QPVEKQVHTGKWK-----VPSYRDYLDLFRNLL	545
GAR	RVCSKPVLLTEEEGAAQGAEGG---RSAGAGQVRTGKWK-----VPSYRDYLDLFRSLL	543
LATIMERIA	RVCSKPVPLSTEGIGKGGLOQSEEEADPAAPGEVRTGKWK-----VPSYKDYLDLFRNLL	543
CAECIL	RVCSKPVTLGKEGSGKSGPGE---EPPVAEEVRIKWK-----VPTYKDYLDLFRSLL	545
SNAKE	RICSKPLVFSMDFGGKNIKSE---EYDSSGEVTRGKWK-----VPTYKDYLDLFRSLL	543
CANARY	RIFSKPITFSKDFSVKETSGETE---EAFEAGEVTRGKWK-----LPTYKDYLYLFRSLL	535
OSTRICH	RIFSKPITFSKEYFGKKTSGSE---ESPAAGEAGAKWK-----VPTYKDYLYLFRSLL	506
GECKO	RVCSKPLAFLRENSGTGVSASE---EHPASGEVRSKWK-----VPTYKDYLDLFRSLL	543
TURTLE	RVCSKPIITFSREIFGKEVSKLE---ESTTAGEVRTGKWK-----VPTYKDYLDLFRSLL	544
ALLIGATOR	RVCSKPIVFSREFDGGKASKSE---EPPAVGEVRTGKWK-----VPTYRDYLDLFRSLL	504
PLATYPUS	RVCSKPVVFLKEAYGRDASESD---DSSAFGEVVRGRWK-----VPTYKDYLDLFRSLL	539
TASDEVIL	RVCSKPVILQKEAFGKEVSESE---EYPSSGEVKTGKWK-----VPTCKDYLDLFRNLL	540
HUMAN	RICSKPVVLPKGP---ESESE---DHRASGEVRTGKWK-----VPTYKDYVDLFRHLL	535
MOUSE	RICSKPVVLPKDV---ESRSD---NRSASEEVRTGRWK-----VPTYKDYVDLFRHLL	535
CRASSO2	RTCSHPPLIETEDMTES-----N--QSEQTGT-----KVTFKDFIELWDTLF	529
POMACEA	RTCSHPVVMGADENQEI-----STAETDLTVK-----QITYKDYLEVWVWGLL	527
TRICHOPLAX	RTCSHPVYVETDSDLNIS-----QDSVILETGP-----RISYKDYISLWKNLI	527
NEMATOSTELLA	RTCSHPVLLDEGPDVVDKQ-----VGVVTGSRSD-----QVTFKDYLPWHEHML	533
PRIAPULA	STCSHPVAMETSSVFS-----QNADDVDDDFQERDPR-----NITYIDYMDMWRHLL	541
SOFTCORAL	RTCSHPVLLDEGVDAM-----EGVTEFDVR-----HISYKDYLELWECFL	528
PISTILLATA	RTCSHPVILKEVNGESTIME-----EREVYEGSTP-----NTSLKDYLELWEYLL	538
HEMICHOR	RTCSHPVVLEGEYDV-----S--GDE--TSDELLIDAR-----KVSYKDYLDLWNHLL	536
BELCHER	RTCSHPNVIEGVTAEDEDLPVA-SGEEGGEQQPQQPPVK-----RFSYRDYLELWGNLL	548
STRONG	RTCSFPVLLSEGGD-----E-GEEQRSDEMEIEQDSR-----RVSYSKSFMDLWTRLL	539
STARFISH	QTCSHPVVLDGSPSID--HPVL-GNDDQDTEADILADAR-----HITYKDYVKLWASLL	542
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70451.1
ARCHAEON	KPTDKTLRLFCLDMLGLSF-----LDVVKQRLVQWLFVSKCMSTIKSLQLTYSKAEELQ	698
MUDCRAB	MPEKVSIV-----KIPGV-----STTILTEISSKLYSEYITSTIEIAEKLDLSTFKQEEIET	590
SCORPION	YIVRNKEL-----NHIGI-----SLEDRHLLQLIYDEIISVVLTLKLLDLATTHSMQDSE	584
SPONGE	DYKCLKGM-----GMDP-----DLELRQSIHQLVYSEFIQSLNLILRKLDFTTASTTEDGI	589
CAPITELLA	TAGLKLKAL-----GQYNI-----TAEQHRVLSAIIYDELLSAMLKMISRDLSSNSTDSESQ	583
DANIO	DCENLKDT-----GFVDGAPAAKNYNLRDLNRHLYDALVQSVMKIVEKLDLSVQKVSAADE	608
MILII	NCGMKKEF-----GLV-DTLQMINLPLQSLNRLLYDEFIKSILKIEKLDLSVEKQONQREE	598
BAMBOO	DCGRMKES-----GLIYETFQMFDSPLKSLNRLLYDEFIKSVLKIEKLDLSVQKQSONEE	602
XENOPUS	RCDQLKDS-----IFSDEIFSTVNSPLQSLNRLLYDELMKSILKIEKLDLSLQKQDTGQE	613
STERLET	ECDKMKDT-----GFVDGAFDVRSSSLHSLNRLLYDELIKSIKIEKLDLSVQKQSADEQ	601
GAR	DCDLMKDF-----GFLEGVFESQSAPLQSLNRLLYDELVKSILKIEKLDLSVQKQNPDEL	599
LATIMERIA	ECDKQKDS-----ALVDETFGVNSPLQSLNRLLYDELIKSIKIEKLDLNVQKQKVGQDQ	599
CAECIL	DCDKMKES-----IFSDEVF-SVNSPLQSLNRLLYDELIKSVLKIEKLDLTVQKQSVGEQ	600
SNAKE	GCDTMKNI-----LLADEVCLTEYSPLQSLNHMLYDELIKSVIKIIDKLDLTVQKQONINEE	599
CANARY	SCDTMKES-----VFEDANFLTEKAQLQSLSRVLYDELIKSVLKIEKLDLTVQKLDISEQ	591
ONSTRICH	NCDTMKES-----VLEDENFLAANSALKSLSRLLYDELIKSVLKIEKLDLTVQKLVNEQ	562
GECKO	SCDTMKDS-----LLADETCLMANSPLQSLSRLLYDELIKSIKIEKLELTVQKQNVNDA	599
TURTLE	NCDTMKES-----VLADETFLLIANSPLLSNRLLYDELIKSIKIEKLDLTVQKLVNSEQ	600
ALLIGATOR	NCDAMKES-----VFADENFLTVNSPLQSLNRLLYDELIKSIKIEKLDLTVQKLVTFSEQ	560
PLATYPUS	NCDEMKDS-----QL-DETFLIVNSPLQSLNHLLYDELIKSVLKIVEKLDLNVQKQNTGEG	594
TASDEVIL	SCDQMKDS-----LLADETFLLVNSPLQSLNRLLYDELIKSIKIVEKLDLKLEKQNVGNQ	596
HUMAN	SSDQMMDS-----ILADEAFFSVNSSSES LNHLLYDEFVKSVLKIVEKLDLTLEIQTVGEQ	591
MOUSE	GCDQMEDF-----ILGDETFVNSLKS LNHLLYDEFIRSVLKIVEKLDLTLEKQTVGEQ	591
CRASSO2	NSPRIKEF-----SVADI-----SVEVRLALTEAVYDELINSVLRMLGKLDLTSQSSTEVAQ	581
POMACEA	ESGKIKDL-----IQDGI-----GFAERDQLTHAVYNELMQAILKVISKLDLTSTTQRESE-	578
TRICHOPLAX	QATEIKGL-----TLITT-----DREHIIVQRSLYNELHSLQRILLKLDLTSSQOTTIE-	578
NEMATOSTELLA	DKTKFKMY-----LLFQSLSLSDIEKRESLHELVEDELVGAILRIIHKLDLTSTKHGQODL	589
PRIAPULA	GSDKMKGL-----NELGV-----SMSDRKALTCVYDEIVTSLMKIVGKLDLSTSKSTDPSQ	593
SOFTCORAL	DGGQYKDQ-----SIMPK-----VSSLTQDIHRAIYDELIQAILKVAHKLNLSFRDQVETQD	580
PISTILLATA	DKDKLKDE-----SLLGK-----QLEERKVMHGLVYDEMIRGILRIIHKLDLSSSKGSSAQE	590
HEMICHOR	DSSQLRI-----TDIGL-----SPQDCKVLHNIYDELIAAIIRILGKLDLSSNKDGQLGN	587
BELCHER	DSSRLKEL-----SQWGV-----AVADRQAMHRMLYDELVTSLKVIDKLDLTTSKQVETGN	600
STRONG	DSKFIKTS-----EAHGS-----SYAERLNHTMIYNELIGGILKVLKLDLSSNKHNEEEA	591
STARFISH	DSTHVKEV-----QAMGM-----NYADRRKIHIIYDELIIFSILKILSKLDLTSNKDTTELQ	594

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70451.1
ARCHAEON	D----V-----NNVGCLPDNIVDQDLFLNLVTFEILVTLLD	731
MUDCRAB	N---DI-----TSDDGDVATSDPISGLSAKTPKDFQVYMNVIALLLEEVL---P	632
SCORPION	I---KD-----SNLKQFETSELYSTVSDPFYGLQLSKPKDFRVFMNIVDFCKDLF---I	632
SPONGE	MANEGEGGGG-----SGGGDPVITSDPVLGRQPAVPKDFQIFINLVELAKKVI---P	638
CAPITELLA	P---S-----TSEPALSDPSSDPLRGLHAVCPEDFILLTNLVELSRDLL---P	625
DANIO	V---Q-SD-A-----SAGIVLSSDPTANLMPNPKPKDFIAFINLVDFCSELL---P	650
MILII	E---GSGDVS-----NGNVIPTSDPAADLQPVKPKDFTAFVNLVQFSTELL---L	642
BAMBOO	G---GSGDVN-----SSIVIPTTDPANLQPTKPKDFTALFNLVEFCGEL---L	645
XENOPUS	D---D-GGIN-----NLLINATSDPAGNLYATKPKDFTAFVNLVEFCSEIL---P	656
STERLET	E---GRSDAS-----SSMLIPSSDPAANLQPSKPKDFTAFVNLVEFCSELL---M	645
GAR	E---ESDVS-----SGVVIPSSDPTAHLLPKPKDFTAFINLVEFCSELL---L	642
LATIMERIA	E---GETDPS-----STIIPTSDPAANLQPSKPKDFTAFINLVEFCRELL---P	643
CAECIL	Q---DASDED-----SALVIPTSDPAANLQPTKPKDFTAFVNLVEFCREIL---P	644
SNAKE	K---DGSEGD-----AHLAIPSTSDPAANLQPSKPKDYSAFINLVEFCREIL---P	643
CANARY	---DGNAGD-----SALVGPSSDPAANLQPTKPIDFIAFINLVEFCREIL---P	634
OSTRICH	---DEDET-----SALVVPTSDPASNLQPAKPTDFIAFINLVEFCREIL---P	605
GECKO	K---DANEAD-----ADLTIPTSDPAANLHPTKPKDFTAFINLVEFCREIL---P	643
TURTLE	---DENEAG-----SDLVVPSTDPASNLQPTKPKDFTAFVNLVEFCREIL---P	643
ALLIGATOR	---AESESG-----DVMIIIPSSDPASNLQPAKPTDFIAFINLVEFCREIL---P	603
PLATYPUS	---DESEVS-----NLWVIPTSDPVANLHPSKPKDFTAFINLVEFCRDIL---P	637
TASDEVIL	E---DESEAS-----GVWVIPTSDPTANLHPAKPKDFTAFINLVEFCREIL---P	640
HUMAN	E---NGDEAP-----GVWMIPTSDPAANLHPAKPKDFAFINLVEFCREIL---P	635
MOUSE	E---DGST-A-----DVWVIPTSDPAANLHPAKPSDFSALINLVEFCREIL---P	634
CRASSO2	Q---QEGPTS-----SNESEDVSSDPLHGMQPNKPKDFQIFINLVDFCREML---P	626
POMACEA	---TSGTEE-----EKSDITQSGDPVHEIEANRPMDFQVLINLVDFSRDLL---V	622
TRICHOPLAX	-----EETQSSEGTSNPVAGLKPNVVKDFQVFINIVDFTKALL---P	617
NEMATOSTELLA	Q---VR-----DQPQEEQEETSDPVAGLQPRVQKDFLVFINLVDFCKALL---P	633
PRIAPULA	V---HDGSGGASSE-----SPDAYSGGSDFADGLVPCRPKDFLVFFNLVEFTKDLL---S	642
SOFTCORAL	E---DLQTEQ--PSSPDAPLLTTSGGTTDPISGIQPEAPKDFQIFINLVEFSRKIL---L	632
PISTILLATA	G---DILGKSSASDVPASATADKEVLSLSDPVPGLQPKVPKDFLIFISLIEFCRCVL---P	644
HEMICHOR	E---LSADPE--PGTSDGRSSPVTDLSSDPSGLTPSKPKDFQIFINLVEFCRDFL---P	639
BELCHER	E---ELTADV--SG-----SQDGTTSDFPAGLQAAKPRDFVVFINVVDFCRDLL---P	645
STRONG	S---TSGGVT--SD-----LEGNTSSDPLEGLQPTKPKDFQVFINLVDFTKELL---P	636
STARFISH	---DQVAVD--SD-----STEDASSDPLHGLHATKPKDFQIFVNLVDFCRDLL---P	638

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70451.1
ARCHAEON	KQDTYNYADFV V FV-- N VMEMSQKLP L LSG F YRMLSCLLIHLEDL-----LACG	777
MUDCRAB	LQYEDQLQGHVSR L CWF F I R CSSE Q PLVSAHYTSLTTILVCAQKMRYFEKTK-----	684
SCORPION	SKHNELFEKWILIFGLE I I Q FINKN P YISG F YK L ITVCLTICKKTRYFQHVKKLKTKEE-	691
SPONGE	SVSLSLFTPWILTF S QEV V SLATRY P LVSG F YK L ITVCL S ICNKTHFFDVHDL S GQGTGD	698
CAPITELLA	VTQTQKFSSW V FPFGH L ILQSS K L P LVSG L YK M LTVCMQVASQISYFKEMNRQLKIETS	685
DANIO	SRNPEYFAQW M HPLCHE L ILQ S IR F PLVSG F YK L LSLSMGIAKKTQYFQDVKQCP-KQVG	709
MILII	ERHEEFDQW V YRFGYEL I ILRST Q F P LVSG F YK L LSATMKI A KKIN Y FKGVSTNTWKQCH	702
BAMBOO	EKHTDFFEHW V YRFGHE L ILRST Q F P LVSG F YK L LSVTMKI A RKIKYFEGVNP K TRKQCP	705
XENOPUS	KEHIEYFESW V YVFGYEL V LQSTR L PLISG F YK L LSVVMKNAKKSRYFEGFTSKIYKKAP	716
STERLET	KEHVDFFEQW V YGLGHE L ILQSTR F PLVSG F YK L LSVSMKI A KRIKYFQGVSPRSCKTSP	705
GAR	KKHVEFFEQW V YPLGHE I ILQSTR F PLVSG F YK L LSVAMKI A KRIKYFKGVSPKSFQPNP	702
LATIMERIA	EKHVEFFEPW M YGF G HE V ILQSTR L PLVSG F YK L LSVSMKI A RKIKYFEGVSSKSKQNS	703
CAECIL	EKHIEFFE I W V YTFGYEL I ILQSTR L PLISG F YK L LSVAMKNAKRTKYFEGVSPKSHKKCP	704
SNAKE	DKHIKYFEPW M YSFGYEL I IQATH L PFISG F YK L LSIAMKI A KKTKYFAGVSP E STKKYP	703
CANARY	EKHVEYFHPW V YSGYEL I IVHSTR L PLISG F YK L LSVTMKI A KRIKYFEDISPRSLRRCP	694
OSTRICH	EKHVEYFNPW V YSGYEL I IHSTR L PLISG F YK L LSVAMKI A KRIKYFEGVSPKSLRKCP	665
GECKO	EKHIEYFEPW V YSGYEL I IQSTR S PFISG F YK L LSIAMKI A KRIKYFEGVAPKSKKKCP	703
TURTLE	EKHVEFFEPW M YSFGYEL I VQSTR L PLISG F YK L LSVAMKI A KRIKYFEGVSPKSYQKCP	703
ALLIGATOR	KKHLEYFKQW V YSGYEL I IQSTR L PLISG F YK L LSVVMKI V KKIKYFEDVSPGTQKKYP	663
PLATYPUS	EKHVQFFEPW V YSGYEL I ILQSTR L PLISG F YK L LSIAIRNAKMKYFEGVSPRSLKKSP	697
TASDEVIL	EKHIQYFEPW I YSFGYEL I ILQSTR L PLISG F YK L LSIAAIRNAK L RYFEGLSPKSHKKSP	700
HUMAN	EKQAEFFEPWVYSFSYELIILQSTRLPLISGFYKLLSITVRNAKKIKYFEGVSPKSLKHSP	695
MOUSE	RKHVGGFFEPW V YSFAYEL I ILQSTR L PLISG F YK L LSIAVKNARKIKYFEGISPKSLKHSP	694
CRASSO2	EKHYKMF G KLFLFSHT L ILQST E K P LVSG Y YK L LAVSMKIANKLNYFQGMVSLSPVKK-	685
POMACEA	PKHFQYFEKW V FTFTHT V VQST E F P LVSG F YK L LAVTMKIANKLEYFKDIAVENSFKK-	681
TRICHOPLAX	TTRTEFFLPW I FPFGKN L VLLSTR L PLVSG F YK L LEICMTISSLSYFEDLN I ETVTKCT	677
NEMATOSTELLA	GQSTDSFGRW V YVFG R D L IVSSSR F PVSG F YK L LEVCMKICKRLRFFQYEVTA-----	687
PRIAPULA	TNQTALFRRW I YTYGHE V ILLSTR W PVSG L YK L ITVCL S ICSSLQYFKAMRKV N DSQLH	702
SOFTCORAL	KT K T K W F ENW I YTFG K ELV V LSAR F PLVSG F YK L L D IVMKISRKLDYFKGMTL K DVSTGC	692
PISTILLATA	NYCVTLFERW I YMF C RD I IIMSSR F PVSG F YK L LEVCMK M CEKLSFFKN I KA E KPDLK-	703
HEMICHOR	KRC P Y F ERW V YTFGHE V IVHSTR L PLVSG F YK L LSVCM T ISQ N IGYFQGINENAKVAVP	699
BELCHER	HHHPEYFQRW V FTVGHAL I LHSTR L PLVSG F YK L LSVCM T ICTKVKYFKDLDTK L LSFS-	704
STRONG	TRQIHLFD P W V YRFGHE L ILQSS Q L P LVSG F YK L L T ICMTMSR K TAFFKEVNP N VTFRTE	696
STARFISH	ANQPALFKQW V YRFGHE V ILLSC R L P LVSG F YK L L T VCMNICTQIQFFK I KPSDLSSQ-	697
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

			RYG70451.1
ARCHAEON	IH-----	ANNEQASVVSCMSQISIFVMK----	LQENLVASPNNDYN 813
MUDCRAB	-----	DPEVETLIHLITSYVKD-----	VLQRCRQLR 710
SCORPION	----ISM-----	SEKDCLIAFELFAKFSRE-----	VVIYLQQFK 721
SPONGE	--DDVAM-----	ETEERTDRQSCYFLFSSFIKE-----	VVVMQYYK 733
CAPITELLA	DS--IKMEMDE-----	EFRTSTAQEEACFMLFTKFAKE-----	VMTRLRQYK 725
DANIO	-----	GSTMENACFSLLAKEFGKE-----	VCVRMKQYK 736
MILII	-----	TDPEKCAFALFGKFGKE-----	VTIRMKQYK 729
BAMBOO	-----	KNPEKFACFALFGKFGKE-----	VAIRMKQYK 732
XENOPUS	-----	EDPERLSCFALFAKFGKE-----	VSSKIRQFK 743
STERLET	-----	EDPKYACFALFAKFGKEVSTILGKEVSVRMKQYK	740
GAR	-----	QDPEKYACFALFAKFGKE-----	VSVRMKQYK 729
LATIMERIA	-----	LDPEKYACFALFAKFGKE-----	VCARMKQYK 730
CAECIL	-----	KDPERFACFALFAKFGKE-----	VSAMKQYK 731
SNAKE	-----	EDPERSSCFALFSKFGKE-----	VTTMKQYK 730
CANARY	-----	EDPEKSSCFALFVKFGKE-----	VAAKMKQYK 721
OSTRICH	-----	EDPEKSSCFALFLKFGKE-----	VTAKMKQYK 692
GECKO	-----	ENPEKSSCFALFAKFGKE-----	VTAKMKQYK 730
TURTLE	-----	DDPEKSSCFALFAKFGKE-----	VTAKMKQYK 730
ALLIGATOR	-----	EDPEKSSCFALFAKFGKE-----	VAARMKQYK 690
PLATYPUS	-----	EDPEKYSCFALFAKFGKE-----	VAVMKQYK 724
TASDEVIL	-----	EDPEKYSCFALFAKFGKE-----	VSIKMKQYK 727
HUMAN	-----	EDPEKYSCFALFVKFGKE-----	VAVMKQYK 722
MOUSE	-----	EDTEKYSCFALFAKFGKE-----	VSVKMKQYK 721
CRASSO2	--EVKMEVDS-----	DQKADIHQRATCFQLIQKFTKE-----	VLVRMKQYK 724
POMACEA	---EEQMDVDE-----	TGIDGQTEKHLTYILIKKFSSE-----	VLVRMKKFH 720
TRICHOPLAX	IN-----	AAAEAESIDKYLCYLLYYKFYKE-----	VLVRLKQYK 711
NEMATOSTELLA	-D-----	DMEIVDTSDCNTCFILFRKFIKE-----	VLIKMKQFK 720
PRIAPULA	---SEAMET-----	DSPDAVDNAEILNCFTLFKKFSKE-----	VLVCLKMFR 741
SOFTCORAL	VD---DM-----	ETDQLDFSDCRNCFILFHKFAME-----	VVVRMKQYK 728
PISTILLATA	---NENL-----	NLEIVDTSDCMKCFVLFHKFTKE-----	IVVRMQYK 739
HEMICHOR	RHIEEKAS-----	TKDMCTLADKVAAFHLFKKFTKE-----	VLIRLKQYK 739
BELCHER	---EESMDTEG-----	RDRPSEGQACFTLFRKFVKE-----	VLVRLKQYK 741
STRONG	VNEEPMDVDDSESIATRTPSNVLSLSDKQACFILFSKFSKE-----		VLIRLKQYK 748
STARFISH	---EDSMDIDL-----	NFSSSSSCVSASDRICFTLFAKFSKE-----	VLVRLKQYK 741

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus “putative archaeon”

		RYG70451.1
ARCHAEON	NELLQSIKVVILSLPIECLSIDCM-----YITLHISLSSNIHLNKCIAMLNKHFTFDPK	867
MUDCRAB	DQLLASCLTLILKLPVCIVIEIFPRLIVPLQMALHLGVSYLPLAEVCI AALCKWTHILPS	770
SCORPION	DELLASCLIEVILSLPTEIVESEINILIPAVQISLQLGLSYLPLAMSCLEDALETWLYSLPS	781
SPONGE	DDLASCLHLILVLPKEMVVSDFKELIPA I KLA LRIGMGYLP LAKSVMEALEKWTLYIVE	793
CAPITELLA	DDLASCLGFILALPREI I ALDVTTFVPALQRSLEIGRSYLP LARTSLNLTLESWSKSLPP	785
DANIO	DELLAACLMFILSLHPGMVALDIKAYIPALQAALRLGLSHAPLATAALDALESWSSFIPA	796
MILII	DELLVSCLNFVLSLPHDI I ELDIKAYIPALQA AFKLGLSHTPLADAGLDALEDWSAHIPK	789
BAMBOO	DELLASCLTFVLSLPHYDI I ELDIKTFIPALQTA FKLGLSHIPLADAGLDALEHWSTRISK	792
XENOPUS	DELLASCLTFVLSLPHDI I MMDIKAYIPALQTA FKLGLSYLP LADVGLNALQYWSTNIPS	803
STERLET	DELLASCLTFVLSLPHDI I VALDIKAYIPALQNSFKLGLSHTPLANTGLYALENWSQFIPK	800
GAR	DELLASCLTFVLSLHHD I VALDIKAYVPALQTA LKLGLSHTPLASAALDALEEWSSRISQ	789
LATIMERIA	DELLASCLGFILSLPHT I VELDVKAYIPALQMAFKLGLSYTP LADSGLDALEEWSNRIPK	790
CAECIL	DELLASCLIFILSLPHDI I MLDIKAYIPALQTA FKLGLSYSP LADAGLDALEDWSAYIPQ	791
SNAKE	DELLASCLTFVLSLPHYNI I MLDIKAYIPALQNAFKLGLSYTPMADVALDALEDWSSYIPR	790
CANARY	DELLASCLIFLLSLPHDI I MLDIKAYIPALQNAFKLGLSCTPMADLGLDALEDWSAHIPR	781
OSTRICH	DELLASCLFLLSLPPDI I MLDIKAYIPALQNAFKLGLSYTPMADLGLDALEDWSAHIPK	752
GECKO	DELLASCLIFVLSLPHDI I MLDIKAYIPALQNAFKLGLSYTPMAEVALDALEDWSAHIPR	790
TURTLE	DELLASCLTFVLSLPHDI I MLDIKAYIPALQNAFKLGLSYTPMADEGLDALEDWSAYIPK	790
ALLIGATOR	DELLASCLTFVLSLPHDI I MLDIKAYVPALQNAFKLGLSYTPMADVALSALEDWSSHIPK	750
PLATYPUS	DELLASCLTFVLSLPHDI I MLDIKAYIPALQMAFKLGLSYPP LADVGLNALLEEWSIYIPR	784
TASDEVIL	DELLASCLNFVLSLPHDI I ELDIKAYVPALQMAFKLGLSYTP LAEVGLNALLEEWSLYIPK	787
HUMAN	DELLASCLTFLLSLPHNI I ELDVRAYVPALQMAFKLGLSYTP LAEVGLNALLEEWSIYIDR	782
MOUSE	DELLASCLTFVLSLPHDI I ELDVRAYVPALQMAFKLGLSHMP LAEIGLHALKEWSVHIDK	781
CRASSO2	DDLAACTLFILTLPK EIVSEQMSSVPAIQLTLSIGLGYLP LAMIALDALDYWSDTLPA	784
POMACEA	DDLASCLTLILTLPK EIIAQQMSKIVPAIQLTFSVGLSYLP LAEVGLDSL VWWSQVLPP	780
TRICHOPLAX	DDLHVSCLSLILALPYQLIQDDMALIIPA I KVSMNIGLSYLP LANAADALERWSSDLPO	771
NEMATOSTELLA	EDLLSCLSLVLSLPHYE I VAVDVAAIVPALELTFKLGLSYLP LAQAGLAALEEWNASLPG	780
PRIAPULA	GDLVACLQLVMALPHYE I VVDIVPEIVPAVQVALKIGLSYPPMAHTTLDALEMWVANLPA	801
SOFTCORAL	DDLKSSCLQLVLSLPHNELVLCIDII I PTLKTA FKLGLSYLP LAEAAALDALDTWTAELPS	788
PISTILLATA	DDLFSCLLVVLSLPLELVTLDLVSSVAALKLTFKLGLSYTP LAEAGLDALESWTTALPA	799
HEMICHOR	DDLASCLFLVLALPHEI I ASDVAAIVPALQTTFRIGLGYLP LAHAGLDALETWAFRLQH	799
BELCHER	DDLASCLLLVLSLPHQIVQSEISTLVPA LQTTFRGLGSYLP LAHAGLDALEERWLLNLPR	801
STRONG	DDLASCLFLILSLPHQVVENQVHDVIPALKTA FKLGLSYLP LAESGLSALQAWIRYIPS	808
STARFISH	DDLASCLLLVLSLPHQIVQAEVAHLVPA LQMTFQLGLSYLP LAETGLEALERWMLHLLP	801
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70451.1
ARCHAEON	----KFLNGTATSLLPLLSKYIVPISMENLSVNERHE-----YVSI GRK-KLKTH	912
MUDCRAB	----DILHQHLPVAVLPLLLPYLRSKETGEVEVQTRVITVKMA-----YANQRR--KVDQK	819
SCORPION	----ELLKEHYCKLLPSLNDYFLASDNISLQPLKNIHTFT-----KQSLVVKKKLPLK	830
SPONGE	SDKMDTLQCLVNEILPLLDAYLKATSVQLKEEEDGGRGKQ-----YATKRYA---RMK	843
CAPITELLA	----DVMKPFYEQLLPYLDAYLTSSADEKNDTL-----SLVQKDPMKKQGKKKIPVK	833
DANIO	----AILQPHYTDILPHLDGYLKTTSSEKDDS---NMEVTF--VSTGSSKGYG-QVLLR	846
MILII	----HI IQPHYKDILPHLDGYLKTAAF-NEAQN---NWEGMN--INNPSRKGGG-KVLFH	838
BAMBOO	----HVI EPYYKDILPHLDGYLKTAAAS-NEFES---NWEMMS--MNT-SSKGGN-KVLIR	840
XENOPUS	----DILKPYKDIIPLLDGYLTNLSSTNESLS---TLDMVR--ISRSLHKGFN-KQLIQ	853
STERLET	----YVMQPHYKDILPYLDGFLKTASNDDEEQN---NWEVMS--LSRSTKGYG-RVLMR	850
GAR	----PLIQPLYRDVLPCLDGYLKTAAASNGSDQN---TWEVMC--LSSGAEKGYG-RVLLR	839
LATIMERIA	----WVLQPYKELPCLDGYLKTSSISAGDTPS---SWEVLR--LSRASQKGDH-KVLIR	840
CAECIL	----YVIQPHYSEILPYLDGYLKTASSADEYQN---SWEVMR--LSRAAQKGFN-RFLVQ	841
SNAKE	----NI IQPYKDIVPCLDSYLKTASSTDESQN---NLEVKK--LSKAIQKGMN-KVVIQ	840
CANARY	----HMQPYKDVLPCLDGYLKSSTSTVESQN---NWEVRK--LSQAAQKGRN-KVVIQ	831
ONSTRICH	----HIMQPYKDVLPCLDGYLKNASSTVEPQD---NWEVRK--ISRAAQKGFN-KVVIQ	802
GECKO	----YTMQPYKDIIPCLDGYLKTSTSTDDSQN---NWEVKK--LSQAVQKGSN-KVVIQ	840
TURTLE	----HIMQPYKDVLPCLDGYLKTGSADESQN---NWEVRK--LSRAAQKGFN-KVVIQ	840
ALLIGATOR	----NIMQPYKDVLPCLDGYLKTATSPDEFQN---NWEVKK--LSQAVQKGFN-KVVIQ	800
PLATYPUS	----HVIQPYKDIIPCLDSYLKTALSDETKN---NMEVTM--LSRATQKGFN-KVVVR	834
TASDEVIL	----HTIQPYKDIIPCLDSYLKTALSDDNKD---NEEVTV--LSRAAQKGFN-KVVIK	837
HUMAN	----HVMQPYKDIIPCLDGYLKTALSDETKN---NWEVSA--LSRAAQKGFN-KVVVK	832
MOUSE	----SILQPYKDIIPCLDGYLNTSTLSDETKS---HWGLSA--LSRAAQKGFN-RHVVK	831
CRASSO2	----SVIRPFYPQILPCLDSYLKTMDQGAD----DVSNTMEM-NKSKSGKGRK-KLPVR	834
POMACEA	----EVLAPHYANILPCLDSYLKTVDTGAE----DVSVELTVTVSSSKSKYRGK-KLPVR	831
TRICHOPLAX	----NIIGPYFSDILPCFDDYLKSSADTTETLVEDSSKALK-----ARTGKAKKLP--	819
NEMATOSTELLA	----DVLRRHLRNILPYLDGYLKSATDAVEEQDQVSRRTATL-RSTYSRLGKILSLYYI	835
PRIAPULA	----DVMQPYKQILPHLDGYLKTTEGAD----SVPTPTVAI-TSANATRGRK-KIPVK	850
SOFTCORAL	----EILHPYLREVLPLDGYLKTASELETSNEKETKL-----RSRKS GK----TK	831
PISTILLATA	----DKLKPFLREILQCLDGYLTTLGDIQLHNE---CNTIVLI-TSSHHTSRGR-KLPLK	850
HEMICHOR	----NALQPYKDIIPCLDGYLKTVDSTNAENA---SSQTVSL-TMTRTGKRRN-KIPIR	850
BELCHER	----SALEPHFPHILPYLDSYLQTAADTGSSSSSD-GFQTVSL-TAASSTRGKR-KIPVK	854
STRONG	----DVLKPYAQLVLPCLDGYLGAGSGSEDEGS---RPEVLVI-QTASSRVGRR-RIPSK	859
STARFISH	----DSLQPHLKVILPLLDGYLRGITITQGSDAADVQTVTMAS-ASSSGRAGKR-KLPAK	855

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus “putative archaeon”

		RYG70451.1
ARCHAEON	LHSSNI-V----NSLQKQQVTTTEQILLFLGKLGHHNQAMLQ---SPSEVIQDSL MWSAET	964
MUDCRAB	KI-----LASKQVDATAMKRVQSLILQLIGGLDPSLQGYVIP-QDADSLAAAAVCWDSQ-	872
SCORPION	ISQYKK- IKQTDLHESELIKVQHRILRF LGSVGNQYNFAMIS-ADKIKIHEVAVAWDINK	888
SPONGE	MVEKWS-EGLHQGSRDDITSVRRRILL LLSLGGV VNESLSKVP----SQHSLVSWDS-	897
CAPITELLA	LLKQTM-FDAEKGKESELKEIQKCVLL LLSLGGG SINHALVFGQTA--NPPDLVAVDSD-	889
DANIO	LLKKSK-R-FSLGDESPIAAVRRRVVRL LHLGGQLNRS LVTAVSAEDMMKRFVAVDCE-	903
MILII	HTKKSK-E-FLVSEDSAITAVRRRIVRL LLSLGGQNNRS LVTAVSAEEMMKRCIAVVTE-	895
BAMBOO	RLKNAR-D-LSMSEETPAAAVKRVVRL LLSLGGQINRS LVAATSSSEEMKKCVAVVAE-	897
XENOPUS	QLKRMK-T-LSVKEESSLTAVRN RVRL LLSLGGQINRS LVTAASTEEMIKRHVSWDTE-	910
STERLET	LLKKAK-R-FSLTEDSPTALVRRRVVRL LHLGGQINRS LVTATS AEEMKKFVAVDSE-	907
GAR	LLKRTK-H-LSMAEDSPSAVRRRVVRL LHLGGQLNRS LVTAA SAEEMKKFVAVDSE-	896
LATIMERIA	LLKKAK-A-VSLNEDSSLGAVRGRVRL LLSLGGQVNRSLVTAASSEEMKKFVSWDTE-	897
CAECIL	RLKTK-T-LSLDQDVSLASIRNRVQIL LLSLGGQINRS LVTASCAEEMKKYVSWDTE-	898
SNAKE	HLKKSK-N-LELEADPSLEAVRARVRL LGLGGQINRH LITGTS AEEMKKFVSWDIE-	897
CANARY	RIRRAK-T-LSVDNSPSLQAVRTRVAR LLSLGGQINRH LITATS AEEMKKCVSWDTE-	888
OSTRICH	HLRRAK-T-SL-VGDP SLEAVRTRVAR LLSLGGQINRH LITATS AEEMKKCVSWDTE-	858
GECKO	RLKKAK-S-LALEEDHSLEAIRMVACL LLSLGGQINRN LVTAA SAEEMKKFVSWDTE-	897
TURTLE	RLKKAK-T-LSLEDNLSLEAVRTRVRL LLSLGGQINRN LVTAA SAEEMKKFVSWDTE-	897
ALLIGATOR	RLRKA K-A-LSLNEDLSLEAMRSRVVQL LLSLGGQVNRSLVTAAS EEMKKFVSWDSE-	857
PLATYPUS	HLKKA K-A-TAPVEDLSLESVTRVRL LLSLGGQINRN LVTAA SAEEMKKCVAVDTE-	891
TASDEVIL	HLKKSK-T-ILSDAEMSLEAVRAQVIRV LLSLGGQINRN LVTAA SDEIMKKCLAVDSE-	894
HUMAN	HLKTK-N-LSSNEAISLEEIRIRVVQML LLSLGGQINKNLLTVTSSDEMMKSYVAVDRE-	889
MOUSE	HLKRTR-N-SSPDEALSLEEIRIKVVQIL LLSLGGQINKSLVTATS-GERMKKYVAVDAE-	887
CRASSO2	ILKGPK-TDSKQVFETQLAKVKQVM TYLGR LGGEVNHALLS-G--SDVCEEAIWDAE-	889
POMACEA	LVKERKPVLDLKGYESQLSVVKQIVTY LLSLGGSMNFALLA-RREEEISRRAIWDTE-	889
TRICHOPLAX	--VKVV-NPTGGSKDSPLAQVRLRIVQL LGR LGGNTNSLVIR-KGNDDGSSQAVAVDNH-	874
NEMATOSTELLA	DFVSKR-NILPQVGESSLV TIRVQILRL LQG LGGHTNLC LLG-SDGGVDSGS AVAVD TV-	892
PRIAPULA	LLQSG-R--KMAEDSALT TARMRIVRF LGG LGGANNIS LIS-CDAEDI AKVAVAVDAE-	905
SOFTCORAL	ASKSSK-RNPNEEENSPLNKVRHRILIL LGLG GKC NLG LLE-GGEGSVASSG IAWDTK-	888
PISTILLATA	LLKMKP-QSQHQMTLTPLAKVRHKILRM FGG LGGETNILLDNTGI--NSSNAVVDTE-	906
HEMICHOR	LLKPAT-Q--DGSDESPLTIVKLVHLL LGLG GSTNGY LLE-SSKEEIAKKAVAVDTE-	905
BELCHER	LLKAAA-E-RNQVQESDLVKARLRIVRF LGS LGGHTNACLVTGLTAEDLAKRAVAVDTQ-	911
STRONG	LLKKA K-D-NDQSQDSPLRSVQLQILRL LGS LGG SVNVG LLE-TSAQELSNVALAVDSDQ-	915
STARFISH	LIK GAS-T-TGQTQDSPLRSVQLRILHL LGS LGGQTNAY LLE-TSAEEIAKKAVAVD TQ-	911

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70451.1
ARCHAEON	KL S L Q L S V S N Q Q G K L E I F I D K L L P T I T E I C R V K I D M T Q T P N V N L I K A L S S A E A L N V V I	1024
MUDCRAB	-KH I R F A M P F G Q A K I D I Y L D D L L P R V D L A L N S S D R Q -----TKVA A S E L L H S I I	922
SCORPION	Q N H L K F Y L P F I D V K L E I F L D K F L P R I V T L S T T A S Q R Q -----TKVA A C E L L H A V V T	939
SPONGE	-R R L G F A V P F S D L K P E I Y L D P Y L P T V C E L A L S S S D R Q -----TKVA A C E F L H A A M L	947
CAPITELLA	-Q H L K F D L P F L D I K T S I Y F D A F L P K V V T L A T V S S D R Q -----TKVA A C E L L H S L V L	939
DANIO	-K R L S F A V P F K D M K P V I Y L D S F L P R V T E L A L S S S D R Q -----TKVA A C E L L H S L V I	953
MILII	-K P L S F A V P F M D M K P I I Y L D S F I P R I S E L A L S A S D R Q -----TKVA A C E L L H S V V A	945
BAMBOO	-R P L S F A V P F A D M K P V I Y L D S F L P R I T E L A L S A S D R Q -----TKVA A C E L L H S V V A	947
XENOPUS	-K R L R F D V P F K D L K P V I Y L D M F L P H I T E L A L S T S D R Q -----TKVA A C E L L H S I V A	960
STERLET	-K R L N F A V P F A D M K P V I Y L D T F L P R I T E L A L S T N D R Q -----TKVA A C E L L H S V V V	957
GAR	-K R L T F A V P F A D M K P V I Y L D A F L P R I T E L A L S T S D R Q -----TKVA A C E L L H S V V V	946
LATIMERIA	-K R L S F A V P F A D M K P V I Y L D S F L P R I A E L A L S S S D R Q -----TKVA A C E L L H S V V V	947
CAECIL	-K R L S F A V P F V D M K P I I Y L D S F L P R V T E L A L S T S D R Q -----TKVA A C E L L H S M V V	948
SNAKE	-K H L N F A V P F V D M K P I I Y L D L F L P R V T E L A L C A S D R Q -----TKVA A C E L L H S I V M	947
CANARY	-K H L S F A V P F A D M K P V I Y L D L F L P H V T E L A L S A S D R Q -----TKVA A C E L L H G I V T	938
OSTRICH	-K R L S F A V P F A D M K P V I Y L D L F L P R V T E L A L S A S D R Q -----AKVA A C E L L H S I V A	908
GECKO	-K H L S F A V P F A D M K P V I Y L D V F L P R V T E L A L S A S D R Q -----TKVA A C E L L H S M V M	947
TURTLE	-K H L S F A V P F A D M K P V I Y L D L F L P R V T E L A L S A S D R Q -----TKVA A C E L L H S I V M	947
ALLIGATOR	-K H L N F A V P F V D M K P V I Y L D I F L P R V T E L A L S A S D R Q -----TKVA A C E L L H G L V M	907
PLATYPUS	-K R L S F A V P F A E M K P V I Y L D V F L P R I T E L A L S A S D R Q -----TKVA A C E V L H S I V M	941
TASDEVIL	-K K L S F A V P F A E M K P V I Y L D V F L P R V T E L A L S S S D R Q -----TKIA A C E L L H S M V M	944
HUMAN	-K R L S F A V P F R E M K P V I F L D V F L P R V T E L A L T A S D R Q -----TKVA A C E L L H S M V M	939
MOUSE	-R R L S F A V P F R E M K P V I Y L D V F L P R V T E L A L S A S D R Q -----TKVA A C E L L H S M V M	937
CRASSO2	-Q H L R F D V P F M D M K P Q I Y F D P F L P R I V E L A T K S G D R Q -----TKVA A C E L L H S L I L	939
POMACEA	-Q H L R F D I P F F D M K P S I Y F D P F L P H V E L A T Q S S N R Q -----TKV S A C E L L H S L I L	939
TRICHOPLAX	-K R L P F A I P F Q D M K P I I H L D P F L P R V E L A T S S S D R Q -----TKIA A C E L L H A L V L	924
NEMATOSTELLA	-K H L P F A V P F Q D M K P T I Y L D P F L P R V E L A T T S S N R Q -----TKVA A C E L L H T L V L	942
PRIAPULA	-K N L K F G V P F A D M K P V I Y F D V F L P R V T D L A L S S S D R Q -----TKV V A C E L L H A L L L	955
SOFTCORAL	-Q H L S F A V P F Q D M K P T I F L D P F L P R V E L A T S S S D R Q -----TKVA A S E V F H S L V L	938
PISTILLATA	-N H L T F A V P F Q D M K P S I Y L D P F L P R V E L A A K S S D R Q -----TKVA A C E C L H S L V H	956
HEMICHOR	-N H L Q F P V P F M D I K P V I C F D P F L P R V E L A T T S S D R Q -----TKVA A C E L L H S L V L	955
BELCHER	-T H L Q F A V P F M D M K P T V C L D P F L P R I C E L A T T S S D R Q -----TKVA A C E L L H S L V L	961
STRONG	-P R L N F P V P F V D M K P E I Q L D A F L P R I V E L A L T S S D R Q -----TKVA A C E A L H T L V L	965
STARFISH	-P R L Q F A V P F V D M K P N I D L D R Y L P R V E L A L T S G D R Q -----TKVA A C E S L H T L V L	961
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70451.1
ARCHAEON	FMIASSASLGV-----NYSDFYKRILPVVLQLASQSRINAFVVLVFESLLDQLVSYFTS	1077
MUDCRAB	LMIGTGSQQQEGI-QAKYPMAALYHHIFQAMLQLACDPDQ-VTRQLFFTLTHQTIHWFTN	980
SCORPION	FMSGCGAQQQPEL-QAIYSMKKLYKNVLPALLQLACDVDE-VARKLFEPFTFQLIHWFTT	997
SPONGE	FVIGKGTQQSVQK--KPNMTKLYQKLIPVALQLACDVDR-VAEQLFRLPVLVQMIHWFTR	1003
CAPITELLA	LMLGRSASQPTGN----PMAAIYRKLFPQMLKLLATDVEQ-VSRQLFEPLMLQIHWFTK	993
DANIO	YMSGKGAQMTEDD-KSAPPMYNLHRKVFPVLLRLACDVDQ-VTRQLFEPLVMQLIHWFTN	1011
MILII	YTLGKGSQISEGQ--QETLYKLNRLQFPVLLRLGCDVDT-VTRQLFEPLVLQLIHWFTS	1001
BAMBOO	YMLGKGSQIAEGQ--QETMYKLNRLHLYFPVLLRLGCDVDK-VTNQLFEPLVMQLIHWFTN	1003
XENOPUS	FMLGKATQMPDDKKTGSSPMYKIYKRTFPVLLRLACDVDK-VTEQLYKPLVMSLIHWFTN	1019
STERLET	FMLGKGSQIPEGE-KSTPPMYRLYKRIFPVLLRLACDVDQ-VTRQLYEPLVMQLIHWFTN	1015
GAR	CMLGKGSQIPEGE-KSSPPMYKLHKRIFPVLLQLACDVDQ-VTRQLYEPLVMQLIHWFTN	1004
LATIMERIA	YMLGKGSQIPERC-GGVPPMYRLYKRIFPVLLRLACDVDQ-VTRQLYEPLVMQLIHWFTN	1005
CAECIL	YMLGKASQMPEKD-QSLPPMYQLYKRTFPVLLRLACDVDQ-VTRQLYEPLVMGLIHWFTN	1006
SNAKE	FMLGKAAQIPEGH-KNSPPLFHLYKRMFPVLLRLACDVDQ-VTRQLYGTLMVMEIHWFTN	1005
CANARY	YMLGKASQMPEGC-QGPPPMYHLHKRIFPVLLRLACDIDQ-VARQLYEPLVMQLIHWFTN	996
OSTRICH	YMLGKASQMPEGC-QGPPPMYQLYKRIFPVLLRLACDVDQ-VTRQLYEPLVMQLIHWFTN	966
GECKO	YVVLGKAAQIPEGQ-EVSPMSHLYKRTFPVLLRLACDVDQ-VTRQLYEPLVMQLIHWFTT	1005
TURTLE	YMLGTASQMPDGP-PGSPPMYQLYKRMFPVLLRLACDVDQ-VTRQLYKLLVMELIHWFTN	1005
ALLIGATOR	FMLGKASQMPEGR-QGSSPMYQLYKRTFPVLLCLACDVDQ-VTRQLYEPLVMQLIHWFTN	965
PLATYPUS	FMLGKASQIPEGN-QGSPPMYQLYKRTFPVLLRLACDVDQ-VTRQLYEPLVMQLIHWFTN	999
TASDEVIL	FMLGKASQIPEGK-LGPPPMYQLYKRTFPVLLFRLACDVDQ-VTRQLYEPLVMQLIHWFTN	1002
HUMAN	FMLGKATQMPEGG-QGAPPMYQLYKRTFPVLLRLACDVDQ-VTRQLYEPLVMQLIHWFTN	997
MOUSE	FMLGRATQMPEG--QGLPPMYQLYKHTFPVLLQLACDVDQ-VTRQLYEPLVMQLIHWLTN	994
CRASSO2	LCVGRSATQPAR---ERYSMAPLYKMFPSILQLACDVDL-VTKQLFEPLLMQLIHWFTK	995
POMACEA	YTLGRSAQQPGEI-QKRNPMDSLYRKLFPALLSLSCDVEQ-VCRQLFEPLVKQLIHWFTG	997
TRICHOPLAX	YMITGRGAQQPGGT-GSVTNYGNLYKKIFPAITLASDVEQ-VSQQLFQPLVYQLIHWFTG	982
NEMATOSTELLA	YMLGKGVTPQDVK-KVALPMQN LWKKLIPVLLQLACDVER-VSAQLFHPLVMQLIHWFTN	1000
PRIAPULA	YILGTGAQQPDSI-KSKRPM SALYSRLFPVLLRLGCDVEP-VAKQLFEPLVMQTIHWFTL	1013
SOFTCORAL	FMLGKSVQIPDA--SSKSPLEKLWKRVFPVVLQLACDVEQ-VSQQLFRPLLFQLIHWFTN	995
PISTILLATA	YMLGKSVTQPG--FKKSPMEHLWKHVFPVLLQLACDVEQ-VSEQLFKPLVLFQLIHWFTN	1013
HEMICHOR	YMSGRGAQQPDST-QVKAPMEKLYKKVLPALLQLSCDVEQ-VARQLFEPLLSQLIHWFTC	1013
BELCHER	YMSGQGAQQPGEM-QAKNPMTRL YKKVFPVLMQLACDVEQ-VARQLFDPLMMQLIHWLTN	1019
STRONG	FMLGKGSQQPDQR-EAKSPMQLYKKVFPVAVLQLACDVEQ-VARQLFEPLVMQLIHWFTS	1023
STARFISH	FMLGKGTQQPEQR-QAKSPMQHLYRRVFPALFRLSCDVEQ-VARQLFEPLVMQLIHWFTG	1019
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70451.1
ARCHAEON	PHHRNSKNEEYGRVLLLETLENIVATNDNNMKELCGTTFTKYLQCCIHSHIRNRT-EGSV	1136
MUDCRAB	NKKNENPD---TAVLLESIMDGIVTANNPALRDVSAQCLAEFVIWSRKQSREKNQ--ASL	1035
SCORPION	KRMINSDE---TKQFVQVIWDGLVQSKDAVFRDFSARCLKKEFVQWSIKQTSVREQEENPI	1054
SPONGE	NTQYESP---TVTLLLEAILEGIEHPTNASLRDFSQAQCIKEFLVWSIKQTSKKQQERSPM	1060
CAPITELLA	SNNSHRPD---TEALLNSLMDGIVSPSDSAVRDFSACKIREFLAWSIKQTSPKEMEAGPA	1050
DANIO	NRKFESQD---TVAVLEAILDGIVDPLDSTLRDFSGTCIQEFVKWSIKQTTTPKQQEKSPA	1068
MILII	NRKFESRD---TVAMLEAILDGIVDPVDSTLRDFCGQCVREFLKWSIKQTTPEQQAKSPA	1058
BAMBOO	NRKFESRD---TVALLEAILDGIVDPVDSTLRDFCGNVCREFLKWSIKQTTPEQQQKSPV	1060
XENOPUS	NKKFESQD---TVALLEAILTGIIVDPVDSTLRDFCGQCIQEFLRWSIKQTTPDQQAQKSPV	1076
STERLET	NTKFESQD---TVAMLEAILDGVVDPVDSTLRDFCGQCVQEFMWSIKQTTTPKQQEKSPA	1072
GAR	NRKFESQD---TVAILEAILDGIVDPVDSTLRDFCGQCIQEFLKWSIKQTTTPKQQEKSPA	1061
LATIMERIA	NKKFESQD---TVAMLEAIMDGIIVDPIDSTLRDFCGLCIQEFLKWSIKQTTTPKQQESTPA	1062
CAECIL	NKKFESQD---TVALLEAILDGIVDPVDSTLRDFCGHCIREFLKWSIKQKTPQOMEKSPV	1063
SNAKE	NKKFESQD---TVTLLLEAILDGIVDPVDSTLRDFCGQCVHEFLKWSIKQTTPEQQEKSPV	1062
CANARY	NKKFESQD---TVAFLLEAMLSGIVDPVDSTLRDFCGQCIREFLKWSIKQTTPRQQEESPA	1053
ONSTRICH	NKKFESQD---TVAFLLEAILGGITDPVDSTLRDFCGQCVREFLKWSIKQTTTPKQQEKSPV	1023
GECKO	NKKFESQD---TVTLLLEAILDGIVDPVDSPLRDFCGRCVREFLKWSIKQTTPEQQERSPV	1062
TURTLE	NKKFESQD---TVALLEAILDGIVDPVDSLLRDFCGQCVREFMKWSIKQTTPEQQEKSPV	1062
ALLIGATOR	NKKFESQD---TVALLEAILDGIVDPVDSTLRDFCGQCIREFMKWSIKQTTPEQQEKSPV	1022
PLATYPUS	NKKFESQD---TVALLETILDGIVDPVDSTLRDFCGQCVREFLKWSIKQTTPEQQEKSPV	1056
TASDEVIL	NKKFESQD---TMTLLETILDGIVDPVDSTLRDFCGQCVREFLKWSIKQTTPEQQEKSPV	1059
HUMAN	NKKFESQD---TVALLEAILDGIVDPVDSTLRDFCGRCIREFLKWSIKQITPQQEKSPV	1054
MOUSE	NKKFESQD---TVALLEAILDGIVDPVDSTLRDFCGRCVQEFLKWSIKQTTPEQQEKSPV	1051
CRASSO2	NNKAEESE---SMALLDAIYDGI IQPNDTALRDFCAVCLREFLKWSIKQTK--NVEKSPI	1050
POMACEA	NKMAESPE---SMALLDSIFDGLVQQDNTMLRDFAAQCLREFLIWSIKQTSKKAMETNPR	1054
TRICHOPLAX	NSNYESVE---TIALLNALLDGV IHSTDSALRDFCAKSLREYLHWSIKQTTKKQEKTSN	1039
NEMATOSTELLA	NRKYESPE---TIALLDALLEGVVHPTDTSLRDFSQAQCIREFLQWSIKQTSKQLEKSPI	1057
PRIAPULA	NRMFESPE---TMCLLDAIMEGIVDATDAALRDFCGSCIREFLIWSIRQTTVRQQERSPG	1070
SOFTCORAL	NKQYESP---TIILLETLLDGI VHPDTALRDL SALALEEFLRWSIKQATKNQLEKSPI	1052
PISTILLATA	NRKYETPE---TMALLDAIVDGI VHPVDTSLRDFSQAQCIKEFLQWSIKQSSEKQLEKSPI	1070
HEMICHOR	NKKFESPE---TIAMLDAILDGI CHPTDTALRDFSACVKKEFLYWSIKQTSKKTMEKSPI	1070
BELCHER	NRKFESEE---TITLLDAIMDGLVHPTDTALRDFSSRCVREFLQWSIKQTTPKQLEKSPI	1076
STRONG	NKKYESDE---TSTLLNAILAGIVHPTDTALRDFCARCISEFLRWSIKQTSKKQQEKSPI	1080
STARFISH	NKKFESEE---TTALLNAMLDGVIHPTDTSLRDFSACCLKKEFLKWSIKQTSKKQQEKSPI	1076
	. : . : : . : : : . : : . : .	

Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus “putative archaeon”

		RYG70451.1
ARCHAEON	NMKVIDTALEELCFLLSHPLESKQAGLLLSNVYKLI RSE LVI V KRFSMFILYLLIKLL	1196
MUDCRAB	NLKSI---LKRIFSFCK HP SAFK R LGGSLAWNSI Y REV RED SLAVETWTLEILSHLMSAL	1092
SCORPION	GMNVV---LNCLYNYSL HP NPYK R LGAALAFNSI Y TIF REE ESLVDKFTLEIAVHF IES L	1111
SPONGE	NTKSL---LKRLYSMSG HP STAK R LGAALAFNSI Y TVL REE ESLVDVFIIEMLVVMVNSL	1117
CAPITELLA	NPKRL---LKRMYSLLE HP SSM R LGGALMFNSI Y SVF REE DALVDQFSLQILSVLVNSL	1107
DANIO	NMKSL---FKRIYSLAL HP SVFK R LGAALAFNS MY RQF REE SSLVEQFVFEVLVVFVESL	1125
MILII	NTKSL---FKRLYSLAL HP NTFK R LGAALAFNS LY REF RQE SALVDQFIFEVLVVYVESL	1115
BAMBOO	NTKSL---FKRLYSLAL HP NTFK R LGAALAFNS LY REF REE SALVEQFVFEVLVVYVESL	1117
XENOPUS	NTTSL---FKRLYSLAL HP NAFK R LGAALAFNS IY RDF REE TALVENFVFEVLVIYMESL	1133
STERLET	NTKSL---FKRLYSLAL HP NVFK R LGAALSFNSI Y RQF REE STLVDQFIFELLVIFVESL	1129
GAR	NTKSL---FKRLYSLAL HP NVFK R LGAALAFNS IY KQF REE SSLVDMFVFEALVIFVESL	1118
LATIMERIA	NTKSL---FKRLYSYAL HP GAFK R LGAALAFNS LY KEF REE SALVDKVFETLVVYMESL	1119
CAECIL	NTKSL---FKRLYSLAL HP NAFK R LGAALAFNS IY REF REEN ALVDQFVFEILVVYLESL	1120
SNAKE	NTKSL---FKRLYSLAL HP NAFK R LGAALAFNS IY QEF REEN ALVDQFVFEALVVYLESL	1119
CANARY	NTKSL---FKRLYSLAL HP SAFK R LGAALAFNS IY REF REEN SLVEQFVFEALVVFLES	1110
OSTRICH	NTKSL---FKRLYSLAL HP SAFK R LGAALAFNS IY REF REEN SLVEQFVFEALVVFLES	1080
GECKO	NTKSL---FKRLYSFAL HP NAFK R LGAALAFNS IY REF REEN ALVDQFVFEALVLYLES	1119
TURTLE	NTKSL---FKRLYSLAL HP NALK R LGAALAFNS IY REF REEN SLVEQFVFEVLVVYLESL	1119
ALLIGATOR	NTKSL---FKRLYSLAL HP NAFK R LGAALAFNS IY REF REEN SLVEQFAFEALIVF IES L	1079
PLATYPUS	NTKSL---FKRLYSFAL HP NPFK R LGAALAFNS IY REF REED SLVDQFTFEALVIFLES	1113
TASDEVIL	NTKSL---FKRLYSFAL HP NAFK R LGAALAFNS IY REF REEE ALVEQFVFEALVIYMESL	1116
HUMAN	NTKSL---FKRLYSLALHPNAFKRLGASLAFNSIYREFREEESLVEQFVFEALVIYMESL	1111
MOUSE	NSKSL---FKRLYSLAL HP NAFK R LGAALAFNS IY KEF REE GSLVEQFVFEALVTYMESL	1108
CRASSO2	NAKSL---LKRLYSYAL HP GAFK R LGAALAFNS IY TVF RED NAMVNLYTFQILVHFVESL	1107
POMACEA	NVTSI---LKRMQSFAL HP SAFK R LGAALAFNS IY MVF REE QSLVDRFTFQILVLFVESL	1111
TRICHOPLAX	NAKSL---LKRLYSLAS HP SAIK R LGAALAFNS IY VVL REE STLVDTFIFEILVNVNSL	1096
NEMATOSTELLA	NIKSL---LKRLYSLAL HP NASK R LGAALAFNS IY TVF REER SLVDVFLVLEILVTYLES	1114
PRIAPULA	NTKSL---LKRMYSLAL HP SAAK R RGATLVFN IY TVL REE EMLVDTFIIEILVTFVDSL	1127
SOFTCORAL	NIKSL---FKRLYSLAL HP SANK R LGAALAFNS IY RVF REE SSLVENFTIEILVTYLES	1109
PISTILLATA	NIKSL---LKRLYSLAL HP SASK R LGAALAFNS IY TVF REE ASLVDIFVLEILVNYLECL	1127
HEMICHOR	NTKSL---LKRLYSLAL HP NVFK R LGSALAFNS IY TVY REE DSLVDQFVLEILVIYINSL	1127
BELCHER	NIKSL---LKRLYSLAL HP NPFN R LGAALGFNS IY RDF REE SSQVDMFTFELLVTFVESL	1133
STRONG	NTKSL---LKRLYSMAS HP SAFK R LGAALAFNS IY TIF REE EVLVDQFTFELLVVFVESL	1137
STARFISH	NTKSL---LKRLYSMAL HP SSF R LGAALTFN IY TVF REED SLIDQFVCEILVTFVNSL	1133
	. . : : : ** : .. * . :* *.: :. : :. *	

Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus “putative archaeon”

		RYG70451.1
ARCHAEON	DVKDLSEE---NEKVCY-PLSSYVR-----TRIRR-----	1222
MUDCRAB	DLAHNDDLVLGTHEQTRAAILHVRRIILIVRKELFWK-MSSNRRIPIDFEGG----TFEDM	1147
SCORPION	ATAHYDDKILGTQDKCKQALNHLERIMEVKAKLLSK-TSKRRRPLRNINDS----ILPEV	1166
SPONGE	KLAHKDAQSIGTVDQCSLSLDHMSRI IKAKSSTCLS KANKNRRVPRGLKSA----DLSIL	1173
CAPITELLA	ALAHRDDKSLGTQEQCKSALLHVERILIKKQVTFNK-DSKQRIKPRGWRDA----NMTTA	1162
DANIO	ALAHFDEKSVGTVQCCSSLDHLKRI IKHKADSLN--INSKRRIPRGFPADQ-SVCLSNV	1182
MILII	ALAHADDNSLGTVQCCDAIDHLNRI IKQKASALN--KPIKGRVPRGFPPDQ-PVSLKEV	1172
BAMBOO	ALAHADDKSLGTIQCCDCINHLKRI IKQKAHELN--KPVKRRVPRGFPPDQ-MVCLTDV	1174
XENOPUS	ALSHADEKSLGTTQCCSDAVDHLKRI IIRKAASLN--KATKRRIPRGFPQGN-TVCLFDI	1190
STERLET	ALAHTEDEKSLGTTQCCSDAIDHLKRI IKQKAASLNAEKTSRRRVPRGFPPDK-PVCLLDV	1188
GAR	ALAHSEDEKSLGTTQCCSGAIDHLKRI IKHKAATLN--KSSRRRVPRGFPPDK-PVSLTDV	1175
LATIMERIA	ALAHMDEKSLGTVQCCDAIDHLKRI IEQKAPSLN--KAATRRVPRGFSPDK-VFCLSDV	1176
CAECIL	ALSHQDEKSLGTVQCCDAIDHLKRI I IHKAPSLN--KTLKRRRLPRGF PSTKSSFCLSDL	1178
SNAKE	ALTHGDEKSLGTIQCCDAIDHLKRI IKHKASTLN--QKSTRRLPRGFPS-R-SICLEDV	1175
CANARY	ALAHTEDEKSLGTIQCCDAINHLKRI IKHKAPSLN--KEGKRRVPRGFPPTK-SVCLEDI	1167
OSTRICH	ALTHADEKSLGTTQCCDTINHLKRI IKHKAPSLN--RAGERRVPRGF PATK-TVCLLDI	1137
GECKO	ALTHGDEKSLGTTQCCDAVDHLKRI IKHKASTLN--KESQRRRLPRGFPPAK-SICLEDI	1176
TURTLE	ALTHTEDEKSLGTVQCCDAIDHLKRI IKHKASSLN--KAEKRRIPRGFPNAK-SVCLLDL	1176
ALLIGATOR	ALTHTEDEKSLGTTQCCDAIDHLKRI IKHKAPSLN--KAEKRRRLPRGFQPAE-SLCLLDI	1136
PLATYPUS	ALTHADEKSLGTIQCCDAIDHLKRI IEKKHISFN--EEKNRRLPRGF PNAR-SVRLLDL	1170
TASDEVIL	ALTHADEKSLGTIQCCDAIDHLTRI IEKKHITLN--KPKRRRLPRGFPPVQ-TLCLLDL	1173
HUMAN	ALAHADEKSLGTIQCCDAIDHLCRI IEKKHVSLN--KAKRRRLPRGFPPSA-SLCLLDL	1168
MOUSE	ALAHEDKSLGTVQCCDAIDHLRRI IEKKHVSLN--KAKRRRLPQGFPPLT-SLCLLDL	1165
CRASSO2	ATAHEDESSMGTQTQCKMVL DHMERI IKVKANVLSK-EDKNRTEPKQWSVV----KLDIA	1162
POMACEA	GIAHQDEASLGTQEQCKKALEHVEKIVCKRVDILRK-PSPHRKEPSEWSKQ----TLDIA	1166
TRICHOPLAX	ALSHTEDEKSLGTQEQLSKALAHIERI IKAKASTLNK-ESKNRRTPTGFM-TK-TVTLHHV	1153
NEMATOSTELLA	ALAHTEDDPAQGTQDQCSQVISHLERI IKTKATLLDK-ENKQRRIPRGFQMLD-SITLSHL	1172
PRIAPULA	ALAHNDEKSLGTQEQAQALDHIERILRGKAHLLNK-DKKSRRRPKEFTDA----TLFTT	1182
SOFTCORAL	EMAHEDDEISLGTQSQCIEVISHLERI IIVSKSSVLLN-VNKKRRVPRGFSAD--TTTLRHL	1166
PISTILLATA	CLSHGDEEARGTQEQCQVQVI IHLERI IHSRAQLLVK-ENHRRRIPRGFASQS-SITLIHM	1185
HEMICHOR	AMAHFDDKSLGTQEQCVRVVDHLERI IRVKANMLNR-TSKTRRVPRDFNRDD-CPTLSHV	1185
BELCHER	ALAHHDEKSLGTQAQCVAVLTHLDRI IITTKADLLNK-HSKVRRVPRGFDRES-PPTLPDL	1191
STRONG	ALAHHDDKSLGTQEQGSEVLKHLERIMRVKAALLNK-ESKNRRVPRGLPEDC-SPTLSHM	1195
STARFISH	ALAHHDDKSLGTQLHGVEVLNHLERI IRVKADMLNK-ESKIRRIREFPAGV-CPTLSML	1191
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		End RYG70451.1		
		Start RYG70450.1 (Archaeon)		
ARCHAEON	IFYFILFCVSR--ALR--HMRTFISLV	TILD-----ADWSSNVVAR--NAATYVANWT	1269	
MUDCRAB	LLWLLLEQCGSPKTLVRHMSMELLESLAPHSKDY--TSVHKFIGQOLEK-PESIKKL----		1200	
SCORPION	VEWLLKNCGCLQTECRHKMELVFQLAPCLSGF--NGCKDYFSHLLET--KGKKKF----		1218	
SPONGE	TAWLLAQCGSIETEARMKCRKLLVQLAPPSSNV--VNIRMWIRKTIES--EGGNYF----		1225	
CAPITELLA	VRWLLRQCGRPQTECRHVCMLVQQLAPCVHEI--NGARELFSVLLSQ--GNSEYF----		1214	
DANIO	VLWLLTQCGRPQTECRHKSMELFFEFVPLLPGN--SSPAMWLDEQLKQ--RGPGFL----		1234	
MILII	VMWLLTQCGRPQTECRHKCMVLFYELVPLLPGN--KTPSCWLADVLKE--RGVSFL----		1224	
BAMBOO	VMWLLTQCGRPQTECRHKMELFYEFPVILPGA--RTASLWLEEILKR--NGVSFL----		1226	
XENOPUS	VLWLLLEQCGRPQTECRHKAMQLFFEFVPLLPGN--KPLTAWLDDQVEK--EGIIIFL----		1242	
STERLET	IMWLLVQCGRPQTECRHKMELFYEFPVLLPDN--KSPASWLDDILKK--QGVAFI----		1240	
GAR	VMWLLVQCGRPQTECRHKMELFYEFPVLLPGG--KNPAVWLEDILKD--EGEGFL----		1227	
LATIMERIA	VMWLLVQCGRPQTACGHKAMELFYEFPVLLPGK--KSPAOWLDEVLKK--QGVSF----		1228	
CAECIL	VPWLLGQCGRPQTECRHKAIDLFCKFIPLLPGN--KSPSSWLNDHLKE--EGISFI----		1230	
SNAKE	VMWLLRQCGQPQTECRHKVMELLFEFVPLLPGN--PSPSSWLGVDLQK--EGIYFL----		1227	
CANARY	VMWLLVQCGRPQTECRHKMELFYEFPVLLPGN--KSPSSWLADTLKK--RTVTFL----		1219	
OSTRICH	VMWLLVQCGRPETECRHKSMELFYEFPVLLPGN--KSPSSWLADVLKE--KGCSFL----		1189	
GECKO	VMWLLFQCGRPQTECRHKAMELFFEFIPLLPGS--KSPSLWLDLILRK--QEISFL----		1228	
TURTLE	VMWLLVQCGRPQTECRHKSMELFYEFPVLLPGN--QPSLWLGDLKK--QGISFL----		1228	
ALLIGATOR	VMWLLMQCGRPQTECRHKSMELFYEFPVLLPGN--KSPSSWLGDLKK--QDSSF----		1188	
PLATYPUS	VYWLLGQCGRPQTECRHKSIELFYKFPVLLPGN--KSPASWLNDILKE--EGVSFL----		1222	
TASDEVIL	VKWLLAQCGRPQTECRHKSIELFYKFPVLLPGN--RSPSCWLTDLILKK--EDISFL----		1225	
HUMAN	VKWLLAHCGRPQTECRHKSIELFYKFPVLLPGN--RSPNLWLKDVLKE--EGVSFL----		1220	
MOUSE	VEWLLAHCGRPQTECRHKSMELFYKFPVLLPGN--KSPSLWLKDLIKK--KGISFL----		1217	
CRASSO2	VRWLMRQCGRPQTDICRHACMKLVHQLAPCITGI--KSTKDYFQTFYKS--EKASYF----		1214	
POMACEA	VRWLVQRQCGRPQTECRHACMQLMYKLAPLIPGI--SSPFDYFKAALDI--QNASYF----		1218	
TRICHOPLAX	VNWLVQRQCGRPQTACRHQCMQLVYGLAPQLSGV--STIQDWVKTIIGS--SSVTFF----		1205	
NEMATOSTELLA	IPLLIKLCKGKQTECRHQCMKLVQVTPLLHGI--GSAAIWMKNTHKE---HDSFF----		1223	
PRIAPULA	VGWLLQQCGRPQTECRHKMELVCKLSMHQSKLPVKSAAEFFRLLLDL--HRAEYF----		1236	
SOFTCORAL	IPWLVVRKCGCSQTECRHQCMRLVSVLAPLLPEC--SSVQTMKKTVES--DGEDYF----		1218	
PISTILLATA	IPWLVKQCGRPSSECRHQCMRLISKLAPLLPGV--NSAADWMKKTHE---DHPSSF----		1236	
HEMICHOR	VTWLLLQCGRLQTECRHQCMILVCKLIPLLPGN--NSASTWMHRTMAEKGRGPDYF----		1239	
BELCHER	VTWLLQQCGRPQTECRHRCMLLVCSFLPLLPRK--PSPQAWMKERLKE--DGPDFF----		1243	
STRONG	VMWLLMTQCGRPQTECRHQCMVLVYGLTSLPLGR--NTPATWMTQNTARE--RGAEYF----		1247	
STARFISH	VIWLLRQCGRAQTECRHQCMILYKITYKIPLLPGH--NTPQTMQNTLKE--KGPDYF----		1243	

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus “putative archaeon”

		RYG70450.1
ARCHAEON	DMLNKFSGCTRA-----VIAYVNE-HVNHRMGSNMVLLLLFVAALDVYNWLVSMQ	1317
MUDCRAB	--VDIEGGGQAG---LGIKHHTEPTSLATAGVPGN-LMNIYFEALLAGLDGYSWLIGKG	1254
SCORPION	--LNCFESEMSN-----TVPSFNQ-NDGLK-PIINWLEGLHTMLDCY YWVFQGS	1263
SPONGE	--VTRFESHGH-----SGILKAPTLAPA----PNIN-IAINWLQSLQA AVDN YRWLLKEQ	1273
CAPITELLA	--IQRFEFGMY-SSARMGLNOKPTMSRVQE-NFSLN-AACTWFDLVLATLDCY TWVFGER	1269
DANIO	--ISCLEGGG-----LLSQPTLREIEA-PFSIR-GTLQWMDLLL AALDCYNTFTNLR	1282
MILII	--IGKFESAGSDHAKCSGI IYQPTLKDLOE-PFSVR-AALQWMDMLLAALDCYNTFVRLA	1280
BAMBOO	--VNKFEAGSDHDNCSGI ICHPTLQALKE-PFSVR-AALQWMDMLLAALDCYNTFIGLH	1282
XENOPUS	--INRFEAGHSDGMHTGIFNIPALHDLHE-PFSMH-AVLQWLDMLLAALDCYNTFIGMR	1298
STERLET	--ISRFEAGREDGGCSGILSQTTLHDLQE-PFSLR-AVLQWMDMLLAALDCYNTFIGLH	1296
GAR	--IRRFEAGRCGDGSSGLLSQATLRDLQG-SFSVR-AALQWMDLLL AALDCYNTFIGLH	1283
LATIMERIA	--IQKFEGGGNTDDRLSGILSQTLCDLQE-PFSLR-AVVQWMDMLLAALDCYNTFIELR	1284
CAECIL	--ISRFEGGGSDGDHQSGLIAQPTLCDLKE-PFSLR-AVVQWMDMFLAALDCYNTFIWMR	1286
SNAKE	--IKKFEGGGCEGENVSGILSHPTLYELOE-SFSLQ-AVVQWMDMLLAALDCYNTFIEPG	1283
CANARY	--INKFEGGGTDAKSPSGILSPTLHGMQE-PFSLQ-AVMQWMDMFLAALDCYNTFFELQ	1275
OSTRICH	--INKFEGGGRDADSPSGIFSRPTLHGIQE-PFSLR-TVMQWMDMFLAALDCYNTFFELR	1245
GECKO	--IKKFEGGGDEGKSVSGILSHPTLSGLQD-NFSLR-AVVQWMDMLLAALDCYNTFIEQG	1284
TURTLE	--INKFEGGGNDGDNLSGILSQTLCDMQE-PFSLR-AVVQWMDMFLAALDCYNTFIEQG	1284
ALLIGATOR	--INKFEGGGNQDDNLSGILSYPTLHHLQE-PFSVR-AVVQWMDMLLAALDCYNTFIEQR	1244
PLATYPUS	--ISRFEAGGTGNDHLSGILVWPTLLDLEG-PFSLR-AVLQWMDMLLAALDCYNTFIEEK	1278
TASDEVIL	--INRFEAGNASEHLSGILAQPTLFDLQG-PFTLR-AVVQWMDMLLAALDCYNTFIEER	1281
HUMAN	--INTFEGGGC--GQPSGILAQPTLLYLRG-PFSLQ-ATLCWLDLLL AALECYNTFIGER	1274
MOUSE	--INTFEGGASSSDQPAGILAQPTLVYLQ-PISLR-GVLQWLDLLL AALECYNTFIEKE	1273
CRASSO2	--INRFEKGQQ----KYGLLSCEPMTAVDS-SFSVQ-NAVSWFDHYLAALDCYIWTFGES	1266
POMACEA	--VVRFEGGGQ-VGDRGGLCGHPTPSKVAE-NFSLK-AVLSWFDMLLAALDCYCWVFGEG	1273
TRICHOPLAX	--ITRFEGGG----SKYGIGRYQTALDISD-TFNLR-SMKNWYDYFLAALDCYSWVFSEK	1257
NEMATOSTELLA	--VRRFEGGGG--RGNGILTYPTLADMGG-AFSLK-ETLLWFHYLLAALDCYTWVFGEQ	1276
PRIAPULA	--IERFEAGGIPGGATCLSNQ---QEGFEA-PISMT-TALSWFDHMLAALDCYTWVFSK	1289
SOFTCORAL	--ILRFECGFA---GKSGIQKHPTLSSINE-TFSLT-TTKHWF DLVLAALDSYIWSFGQR	1271
PISTILLATA	--VHRFEGGGGG--GQKGIEQYPTLAHIGG-HFSLK-ETILWFEFVLAALDCYTWSFSEH	1290
HEMICHOR	--ITRFEGGGGKGGHKTGISKHPTLNTVDK-TFSVK-VASNWF DLFLAALDCYTWVFGEK	1295
BELCHER	--ITRFEGGGGKTGHKSGIKKHPKISTMDS-TFTVK-TAVSWFDLLL AALDSYCWVFGQR	1299
STRONG	--VGRFEGGGHK----SGIQKQPTLASVEQ-QFSVK-ATITWLEYLLAALDCYVWVLGES	1299
STARFISH	--VSRFEGGGVKAASRSGISKYPTLSTMGQ-PFSVK-LACSWFDHLLAALDCYTWVFGEK	1299
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70450.1
ARCHAEON	IIQVSELFDSVSNNGEYSCRIFSHIKSVLDSY-----ISST-----	1354
MUDCRAB	IVPADKLLKCKE-----SRILLASSYFLQNIATKSLSQYVKDNIRVSE----TGAIGS	1303
SCORPION	VLKLSDFINDAS--NRE--SKFFPSIEFFLKTLCIDFDQRVQAFTHESV----KKQIFS	1315
SPONGE	YVSPREIFSSTS----S--SNLFKSIDHFLKCIALVGIEGVVNSPEV-----AMATS	1319
CAPITELLA	LMSPNQILIASN--NKG--TIIFQVLHFFMEELAQEDISAAVKLFPKQVAD----GSSIFT	1321
DANIO	CLQLQRILGTCE----K--SSFLPAVHFFLTELQSMQDIQAARACFRLGNA----GQSHFS	1332
MILII	MVKPSELLGTSQ----E--TGFMKAMNFFLKTTLARHDITAAEECFTLGVK----GVL-FS	1329
BAMBOO	LVKPSKIMGTSE----N--SSFLKALNFFLTNLARHDVTAAEESFAYGIK----GIL-FS	1331
XENOPUS	FLKANTVLGKNAE---K--SSFLKAAFFFITSLSMENIKAAEQCMGSKS-----S-VFS	1346
STERLET	LVKPHEVLGAKV---Q--SGFLKAIEFFITELAVQDISAAELCFVSGPK----GAL-FS	1345
GAR	FVKPQQILGTQE---K--SSFLKAIGFFIAELTMDISAAERCFSGSE----GSL-FS	1332
LATIMERIA	MINPREIFGTTS---V--SGFLRAVEFFLTRLATQDITAAEQCFRTAGSK----DTM-FS	1333
CAECIL	AIKPNEILSTTT---Q--SSFLRTCEFFLQKLCIHDITAAEQCFRTGPS----GNI-AS	1335
SNAKE	MIKPSEIFASNT---G--SSFLKSLEFFLQKIALYINISGAEQCFSSASK----GDMLLS	1333
CANARY	MIKPDEVLGVNE---R--SLFLKAVQFFLDTIALHDIHAAEQCFDSSSK----GSM-FS	1324
OSTRICH	MIKPHEILGVNE---R--SSFLKAVRFFLETIALHDIHAAEQCFDCGLK----GSV-FS	1294
GECKO	MIKPNEIVATNT---E--SSFMTSVEFFLEKLALKDVSAGAEQCFNTASK----GNI-FS	1333
TURTLE	MIKPNEILGTKM---R--SSFLRAVEFFLKTIVLHDIHAAEQCFDTGSK----GNM-FS	1333
ALLIGATOR	MFKPENVLGTN-----SSFLRAVEFFLETIALHDIHAAEQCFYTKSK----DNV-FS	1291
PLATYPUS	TVKAHEILGTQA---K--SSFLRAISFFLERIAFHDIHAAEQCFGTGSK----GSM-FS	1327
TASDEVIL	AIKAQEILGTKA---K--SSFLKAVGFFLENIALHDIRAAEKCFGTGIK----GNV-FS	1330
HUMAN	TVGALQVLGTEA---Q--SSLLKAVAFFLESIAMHDIHAAEKCFGTGAA---GNR-TS	1323
MOUSE	TVQGQEVLGAEV---Q--SSLLKSVAFFLESIAHARSARAVEQRFVSGGAP----GPP--S	1321
CRASSO2	LLNPDDIFSGEG--RKQ--SKLLQAMQHFLSQVVMEDMDEVGKMRHEP-----LTDVYT	1317
POMACEA	LLSPAKMFESSG--FKG--TRVFSSLOQFVTEMALGDLVAAKQFQRKA-----EAVFFT	1324
TRICHOPLAX	MMSPQIIGDKAQ-LGS--CKIFGSIEFFLSKLCIHLSDETVKLLYSK-S----TLQLFT	1309
NEMATOSTELLA	LLPPADLLRSKY---S--SVLFTSLSYFLSNLAMLGIQAAIKCFPKTTH----ITDVAT	1326
PRIAPULA	LLQPTALFAGGTGKREE--RTCFAVMSDFMRPSGEE-----RRRRRRWADRRHVH	1337
SOFTCORAL	LLTPSSIFQGKT---T--SVLWRTLLYFIEKLSLNGIEKAFECFPTTSDG--VNTHAFS	1323
PISTILLATA	LLSPSWVFTSSEDNEMP--SVLLVSLKFFLSHLAMFGITEATSCFTSGPS--RGMGDIFT	1346
HEMICHOR	LLGPIELFAGKA--NKP--TNVFKSVDFLSKLALEDVYAAAKCITSSS-----AGLIFT	1346
BELCHER	FLSPSDVLSGSG--KKP--SQLFTALEFFLTKLALSDDIAAARCFESHG-----AATLFT	1350
STRONG	LLTPAAVFKTIKE--GKK--SVLFQTTIDSFMKVAQ--YDLFAFAK-----GCGSMETAFT	1348
STARFISH	LLSPSVVYTATA--RRP--SVLFQSLQYFLSSLSLLDITGAARGIEYGGSKTSAFHQVFT	1355

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70450.1
ARCHAEON	--VTSNSDWRQEDAWIRSVVFLTTIIISKSPSGRTLTELQAFGIPITSLFRNLVHFSLNYS	1412
MUDCRAB	PLEYEASNKLKCTVVVRLFDVFCVLLQDGVQS--VQLLNEYSIFTAEMYGLI-LQCVLNP	1360
SCORPION	PKEKDEYLRNCFIIVRLINFVTTIVENYHLQ--LNTIPSTFW SINFWNCI-YSSVLNP	1371
SPONGE	IHERGEYQRNKWCTIELLTLFIELLLTKHTSETVSFEYVPDSLWSQELYTIV-MDSL FYS	1378
CAPITELLA	PREREDYNQTKCTVIVRTLSEICTMFGNYKTE--SLKVIPTSFWSSNLWDTL-LLAVLQP	1378
DANIO	PRETEQYNYSKCSIIVRMLEFSTMVLQKCPQD--LWKLMEKDFVNSSLFTLV-VLAVCEP	1389
MILII	PREREEYNYKCTIIVRIMEFACLILEGLQD--CWKVLEKDLLNSDLFELI-AMVVIDP	1386
BAMBOO	PREREDYNFNKCTIIVRIMEFVSMVLEDCQQD--FLKMLEKYLLNSTLFELV-ATVVIDP	1388
XENOPUS	PHEIEAYNYSKCTIIVRIMEFITMFLIDICQQD--SLKILENSVFNEPMWELI-AITVCDP	1403
STERLET	PKEREDYNYSKGTIIVRMMEFVSMVLENCQPE--FWKLEQNILNPTFFELI-TTTVCDP	1402
GAR	PREREDYNYSKGTIIVRLMEFVTMVLKCSQD--LWKVLERDILHLTFELI-ATTVCEP	1389
LATIMERIA	PREREDYSYSKCTIIVRILTFVSMVLEKCPD--LWKVLEKDLLTPALLELT-VRTVCEP	1390
CAECIL	PQEREDYNYSKCTIIVRIMEFVSMILENCQQD--FWRLLEKDLLNNNLVELT-VLTVCDP	1392
SNAKE	PHEREEYNYKCTIIVRIMVFGSMILETHQQH--VWKLEKELLNENLIKLV-VKTICDP	1390
CANARY	PQERDKYNYSKCTIIVRILEFVTVILEMCQQD--FWKLEKELLNASFIELV-VMTVCDP	1381
OSTRICH	PQEREVYNYSKCTIIVRIMEFVTMVLSCQQD--FWKLEKELLNASFIELL-VMTVCDP	1351
GECKO	PQEKEDYNYSKCTIIVRIMVFSMILETCQQD--FWKLLERELLNKNLIELT-VRTVCDP	1390
TURTLE	PQEREEYNYKCTIIVRIMAFVSMILETCQQD--FWKLEKELLNANLIELL-VRIVCDP	1390
ALLIGATOR	PQEREEYSYSKCTIVVRIIRFVSMILETCQQD--FWKLEKELLNLNLIELL-VVTVCDP	1348
PLATYPUS	PQEREEYNYKCTIIVRIMEFATMLLNTYQ-D--TWKLEKDLLNATFMELV-VEIVCDP	1383
TASDEVIL	PQEREEYNYKCTIVVRIMEFSSMLLNTCQ-D--VWKLEKDLLNAYFMELL-VKTLCDP	1386
HUMAN	PQEGERYNYSKCTVVVRIMEFTTLLNTSP-E--GWKLLKDLNTHLMRVL-VQTLCEP	1379
MOUSE	LHEEEKYNYSKCTVLRIMEFTTLLLIASP-E--DCKLLEKDLNNTLMQVL-VKMICEP	1377
CRASSO2	PKERDEYNRTKCTAVVRTLNFVFCVLVARSPTS--VKKLLPSEILGKDLWNLI-SMCVLQP	1374
POMACEA	PKEKDDYNKVCTVLRIMWNLTVLIARYPSE--AFKVIPQTLFCDDLWRLC-IRCVVQP	1381
TRICHOPLAX	PREIEEYNYKCTTIVRLINFVAVLLQMSPTS--IIEGIPRQIWSQNLFEMI-FLCILTP	1366
NEMATOSTELLA	PKEMDEYNRVKCTVIVRIMNFVTVLLQAYPDQ--GFKIVPTSLWSDDLFTVV-FSCALEP	1383
PRIAPULA	PGEMEKYNRSKCMVVIRAMDLSFILLNMA----SLQVIPDSTWSMELWDVV-LLSVLDP	1391
SOFTCORAL	PSEIQEYNRAKCTVLRVRIIAFITLILLQMNAKE--YLEIVPSELWTGKFFEAL-CTSVLEP	1380
PISTILLATA	PKEIDDYFRAKCTVIVRVLNFLTILLQDFPQE--TLKTLPPPEFWSEDLFEVV-LSCVLEP	1403
HEMICHOR	PREIDDYNYKCTAIVRLLDFISVLLAVHTKD--LSKSIPLSFWSTNLFEVI-VSCVLDP	1403
BELCHER	PRETEDYNYGKCTVIVRIMDFVTVLLGAFPQD--AYKVVPDAVWKSPLYDMV-VTAALEP	1407
STRONG	PREEDYNRTKCTVIIRLFYFMGAMLSHTKE--ALEVIPSKLWTGLFAEIL-CGCVLKP	1405
STARFISH	PRESEFYNQEKCTVIVRLWDLFTVLLENYASD--AVKVIPKSIWQDSLFDLV-VTCILQP	1412
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus “putative archaeon”

		RYG70450.1
ARCHAEON	TSLYPNTGDIYN-----TVFTFMKAALEIAPAS-----LCDEIS	1446
MUDCRAB	SSVGFVDKDEVTKHLPSRMEEV LKVMQKKV PNVVSAAFIQ TLEKYL GSPQ-YDVLETFT	1419
SCORPION	KFLGFDMDTYIFNQFPKETRTLLKVFYEYMPKPLYNNFNEHLYEYL--ESKCNINLFP	1429
SPONGE	SLVNTAPDDPSTAKRISEAAVSCLTAMCTSLPIDVKQNLIAIASNINTGQTNNVINRLP	1438
CAPITELLA	TQLGFNMGQVEVMNHLPEQTLGTLQILMRS LPRNLAQELIESVSRHLN-MSSCDLSSKLP	1437
DANIO	SSIGFN MADLEV MTHLPEVCFPLLKALASA---PYRTQLESCIRMRITKQSVEELCAID-	1445
MILII	TSIGFN MADVQVMKNLPNVCV KLLNAVMS---PFKETLVDSVRKRIT AQSI EALCNVD-	1442
BAMBOO	PSIGFN MADVQVMKGLPDI CVRLMKAALRS---PYQESLECSMKRRLKSQSIEDLCNVD-	1444
XENOPUS	SSIGFN TADVEVINNLPNICIKLMKALGNT---SYRSSLEVSLKRVTLQSI EELCSVD-	1459
STERLET	SSIGFN MADVEVMKNLPDI CVRLLKALAKS---PYKGQLEISMRRISYKSVEELCGVD-	1458
GAR	SSIGFN MADMEVMTNLP EVCVHILKALLKS---PYKTQLEQSIRRRVSQQNVEQLCAVD-	1445
LATIMERIA	ASIGFN TADVQVMKNLPEICV RLLKALMKS---PYKDTLEASIRKRITARS IKELCSVD-	1446
CAECIL	SSIGFN VADVQVMKNLPDVCIKLLKGLMKS---PFKNDLEFSIKKRITSESIKDLCDVD-	1448
SNAKE	ESVGFNI ADVQVMENLPSICVRLVKALMKT---PYNESLENSIKEIITMKSIEELCTVD-	1446
CANARY	SHVGFNT ADVQVMKLLPDISVRLMKALMKS---PYQESLKLCLKERITPQSLEDLCSVD-	1437
OSTRICH	SHVGFNT ADVQVMKNLPDISVRLMKALMKS---PYKESLKL SLKERLTPQSLEDLCSVD-	1407
GECKO	KSIGFN TADVQVM EKL PDI CVRLIKALMRS---PYKESLVTSMKKVITPESIEEFYGV E-	1446
TURTLE	ANIGFN TADVQVMKNLPDVSRLIKALMKS---PYKESLELSIKDRITSQSI EELCSVE-	1446
ALLIGATOR	SAVGFNT ADVQVMKNLPDNTVRLMKALAKT---PYKSSLELSIKKRITSHSIQELCSVD-	1404
PLATYPUS	SSIGFN VADVQVM SNLPDVCV SVMKALKKS---PYKDALEGNIKKRVTAQSI EELCTVD-	1439
TASDEVIL	SSIGFN IADVQVMN NLPNVCV NLLKALKKS---PYKESLEINIKKRITPQSIEVICAVN-	1442
HUMAN	ASIGFNIGDVQVM AHL PDVCV NLMKALKMS---PYKDILETHLREKITAQSI EELCAVN-	1435
MOUSE	MSLGFNIGDVQVMNHLPSICV NLLKALRKS---PYRDMLETHLKEKVTVQSVEELCSIN-	1433
CRASSO2	SAVGFNLGDVEI IKNLPTEMEQLLKV LNAKLQPDVLAAMCKEFGRL--QGDRDLSGLLS	1432
POMACEA	SSVGFNMGDIEIITKLPHEMMQVLKVL SKQLPLPERKELVKILEQEL--KGKDLFGQIP	1439
TRICHOPLAX	HQLGFNVGDI EIVLEKLPQOMKDVCGLFQMKLPKDKRELMITLKE LLSRNRSYNLPDLLP	1426
NEMATOSTELLA	ALIGFN VGDVEVIEKLP EQVSMTEAAWHISMFLG-----FSRCNLF EKLP	1428
PRIAPULA	TRVGFNMADIEVVEKLP EQTERLLIALSWKLPNAPKKELHSRVAR----SLSEKKNILP	1447
SOFTCORAL	QSLGFNVADLEVLEKLP EQTFELCKSLASKLPKQFLIHLTTTLM SKISLGGR CNLFELLP	1440
PISTILLATA	GVVGFHMGDVEVVEKLP EQTGVLC KLLVQRLSGECLERLKG TLEKKIALGSHCNLFDQLP	1463
HEMICHOR	SSVGFDLADIEVISNLPKTTGQLLMFMTQKAPGNVSSEMKKCLQEKLKPKSHMHLMNITP	1463
BELCHER	TALGFNMGDVEIMEKLPQETKQLLLLMCRSLPSQQGALLKSQVAAKLSRRSSHDLFSHLP	1467
STRONG	ASLGFNMADTVIMNALPQTTRVLDLLYTKLPTEQLKKLETVIHKRITASRSEDLFSILP	1465
STARFISH	TVVGFNMADVEIMN NLPKTTTRKLLRLMSTHLPANLRN NLSKAVTRSVTKSSHDLTKLLQ	1472
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70450.1
ARCHAEON	GILVGAVDAQVQHFOQIQSDDENSYSLVKRTQLLLKLALALRP-----GVVATSVIHSEV	1501
MUDCRAB	SPLAE---GWNVPLK-----SQHVI EGLQI LQRS-GWLAQ-----CSVIRKSLASEL	1462
SCORPION	LNLN---DKDLKILE-----IQEMLLGYEQLIEN-KL----WPKQNCNKSKKLACDM	1473
SPONGE	VSYN-ESTTSSGILL-----FNRLVQGHIIYLAESNKCLSDVLKSMGISEEESLAMRL	1489
CAPITELLA	IPLL---EPNQDYIQ-----LRLLVSGFEQLNSA-GLLSNTLVS---KSSEKLAEDL	1482
DANIO	--LY-ETDTRNSHAS-----MNL LLSACRQLHQ S-GLLNSVLHSQDASYGCSLGSKL	1493
MILII	--LY-SPGARTDHAG-----LRSILSACQQLHKA-DLLNSAIDCEAGSLSSSLSLKL	1490
BAMBOO	--LY-SQ---SDHAK-----LNSILLACKQLHKA-GLLNSVLKQCIGSIVPPLNLKL	1489
XENOPUS	--LY-DPGARFNVRK-----LGSVLSACKQLYKA-EFFNSIVPEQVGGQ--RFGSKL	1505
STERLET	--LC-NVDARSDRAR-----LVFVLSACKQLHKA-GLLNSALQSQAASFGLSLGSKL	1506
GAR	--LY-GSEARSEHAR-----LALVLSACKQLHRA-GLLNSTLQSQAASFGLSLGSKL	1493
LATIMERIA	--LY-NPDARLDHIR-----LGSILSACKQLYDA-GLLNSAVQYQSGDFNLQLGSTL	1494
CAECIL	--LY-NQDARHYHAR-----IGSILSACKQLHKA-GLLNSVLQSQTAGLQFTVGSKL	1496
SNAKE	--LY-NPEARLDHVR-----YIAILSACRQLHKA-GVLHCILQSKGADLQFETGSKL	1494
CANARY	--LF-NSEARLDQVR-----FGAVLSACKQLQKS-GLLHSVLHGQDEGSHFSVGSKL	1485
OSTRICH	--LF-NSDARFDQVK-----YSAILSACKQLQKA-GLLHSVLHNQDEVPHFSLGCKL	1455
GECKO	--LY-NPDSRLDHVR-----LGAILSACKQLHRV-GLLHCTLQSQGVGLHCEAGSKL	1494
TURTLE	--LY-NPDARFDHVR-----LSSILSACRQLHKA-GLLHSTLQSQSGSLHFTVGSKL	1494
ALLIGATOR	--LY-DPDARFDRVR-----ISSILSACKQLHKA-GVLHSVLQSQSGSLHFTVGSQ L	1452
PLATYPUS	--LY-KPDARFDRPR-----LASILSACKQLQRA-GLLHAAVHPQASHLQRPGSTKL	1487
TASDEVIL	--LY-NSDARFDRAN-----LASLLSACKQLHKA-GLLHSTVESQATDLPHPIGTKL	1490
HUMAN	--LY-GPDAQVDRSR-----LAAVVSACKQLHRA-GLLHNILPSQSTDLHHSVGT EL	1483
MOUSE	--LC-SSGARQERSK-----LLSILSACKQLHKA-GFSHVISPSQSTALNHSVGMRL	1481
CRASSO2	RPLDD---PSTDHVF-----LQQLVSGYQLHHSV-GLLSKVSM--ATTLPD-LANKL	1477
POMACEA	ISLTS---SSIDYTN-----LQQTVEGYCQLHDV-RILLEVLG--KHGQPEKLAELL	1485
TRICHOPLAX	IRFDRDNELNIDFER-----LTFLIKGYKQLLTM-GILKTTPADHK----DLIEKI	1472
NEMATOSTELLA	IPLAGE-DSRVDHLY-----LSHLVTGYKQLHAA-GLLMDVMLTRGSTKPLEYGSRL	1478
PRIAPULA	RLPCLMTDTGDDTRY-----LSSLVCGYEQLYKA-ELLLPALQEAAAP----ALPASL	1494
SOFTCORAL	LPLSGEEDQMDHTR-----LQLLVRGYQQLHRA-EILLPALAKEGEWSAEKCS EEL	1491
PISTILLATA	FPLSNPQEHQVDCLR-----LAYLVQGYQQLHCA-GLLLPALKAQARNASEEYAVKL	1514
HEMICHOR	SILKGD-DKGINYVK-----LTHMVSQYEQQLHKA-NLLLPALQKTGMASGDKFSQQL	1513
BELCHER	EVSAGV--AELDHVR-----LTLMVSGYQQLHNA-GLLLPALQKTGMASGDKFSQQL	1513
STRONG	MLFSNESDLGLDHVQ-----LQHLVNGYKQLQKA-KLLTRQT--TNQALS-----I	1508
STARFISH	SMFGRDEGLTTDHGK-----LIHLVKGYEQLHQQA-NLLSAAT--TGHGSGSSFAVKL	1521
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70450.1
ARCHAEON	LNV---IFHLCRVSADEM--KLIKKS----DTTAE LLSLL FAGDLPFYSSGLSLSQETLV	1552
MUDCRAB	IMW---VCNSLFMYG-----SASSPHPTQLPFLHV VLD FAVTLDS-----QVLELL	1505
SCORPION	LSS---VWESCILETEIG-CCIPILNPSVLN FNGKMLT VALKLDI-----SSEDL	1520
SPONGE	YTNALT I IRGISSSPGDGTP-GYMPPLHKL TGELLLK LGLELSD-----SVEPFL	1539
CAPITELLA	VNT---VFMGMVTAVD-GKPTLVNLS PVSQSLAEKMLT LAFQMGY-----PEKNLV	1529
DANIO	LTS---VYKSIAPGTD R--KSLPSMDVGS RKLAD RLVQL SFCLGD-----QSEQTV	1539
MILII	LSV---VYKGIAPGDER--KSLPSIDVSS Q LAD GLLQL SFSLGG-----QCEELV	1536
BAMBOO	LST---VYKGIAPGDER--KSLPTMDVSS KMLADGLLQL SFSLGG-----QCEELV	1535
XENOPUS	LSV---VYKGIAPTNER--KSLPSLDISS KRLAEG LL ELAF MF GG-----QCEELV	1551
STERLET	LSV---VYKGIAPGDER--KSLPSMDVSS RKLADGLLQL AFSLGG-----QCKELV	1552
GAR	LSV---VYKGIAPGDEK--KSLPSMDVSS RRLADGLLQL AFSLGG-----QSEQLV	1539
LATIMERIA	LSV---VYKGIAPGDER--KSLPSIDISS KRLADGLLQL AFS FGL-----QSGELV	1540
CAECIL	LSV---VYKGIAPGDER--KSLPSLDISS KRLADGLLQL AFDLGG-----QCDELV	1542
SNAKE	ILV---VYKGIAPGDEG--RSLPSLDIGS KRLAEG LL HLAF AFGV-----RCTELV	1540
CANARY	LSV---VYKGIAPGGER--MSLPCLDLS RKRLAD G LLQLAF AIDE-----QCEELV	1531
ONSTRICH	LSV---IYKGIAPGAER--LCLPSLDIS KRLADG LL QLAF AIDG-----QCEELV	1501
GECKO	LLV---IYKGIAPGDER--KSLPSLDMS S KRLA EGLLQL AFAFGV-----QCKELV	1540
TURTLE	LSV---VYKSIAPGDER--KSLPSLDISS KRLADG LL QLAF AFGG-----QCEELV	1540
ALLIGATOR	LSV---VYKGIAPGDER--KCLPSLDISS KRLADG LL QLAF AFGC-----QSEELV	1498
PLATYPUS	LSV---VYKGIAPGDER--QSLPSLEISS QLASG LL ELAF AFGG-----LCEELV	1533
TASDEVIL	LSV---VYKGIAPGDER--TALPSLEISS KRLASG LL ELAF AFGG-----LCEELV	1536
HUMAN	LSL---VYKGIAPGDER--QCLPSLDL SCK QLASG LL ELAF AFGG-----LCERLV	1529
MOUSE	LSL---VYKGI VPAEER--QCLQSLDP SCKSLAN G LL ELAF GF GG-----LCDHLV	1527
CRASSO2	LEY---VHSSLIC VEG-GTKKSQTP SPTAQV TATRM LE LSF CLGV-----QIKK VV	1524
POMACEA	FDS---VLKGIT EKKD-GKDKTV SLS PAHRFASQ LL KLAF QLGL-----PAEK LV	1532
TRICHOPLAX	MKS---V--VDCFRG REMNGDR TALSPA Q Q VAAE LL DLAF ELNE-----TIDIF F	1518
NEMATOSTELLA	LNA---VYEGACRA AVRTSGS IIVLSPASH QLACK LL ELAF DLGI-----EVIT IF	1526
PRIAPULA	LTS---VFEGCTLS PRDGVSSL TGMSPSVREL GGRMLR LAF TMKV-----ESD SL	1542
SOFTCORAL	LKS---VFQGFIVQDS D-VFRIVNL TPASRELAK LLDL AFDLGL-----KIES VL	1538
PISTILLATA	FTA---VYDGVK PSLNVG-LQTVIL DPAS QHLASK LL DLAY DLGL-----QFN YLM	1561
HEMICHOR	LTA---VFESIST KQSN-SLIVSH LSP TAHELAVR LL DLAF LLAS-----QSK ELV	1560
BELCHER	VSA---VFKSM VTRKD-GHPTAAS LPPSFH QLTG GL QLAC QLHP-----QGH DLL	1560
STRONG	LDF---VMRGL VKRG ENGQ-EARK MTPSE IDL QRLL ELAF QLGV-----QT NSLI	1555
STARFISH	FIT---VFD SLTTSDE AGLL QANL TPLSV ELAES LL DLAF LLGI-----EAK MLV	1569
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus “putative archaeon”

		RYG70450.1
ARCHAEON	FSDSAAAKNPSLLSV-----IAHPKY GSKLY QQYSRLIIDAVVTAPSSSPVSLYH	1602
MUDCRAB	VKQ---VTNMEDVKG-----VTGQQIEK GFHIL NVLGNKIIIPHILPCCD-----	1546
SCORPION	KKL---LD-EQQLYVSNLK-----TKTRR GLIMF STYQQEISLFAGINSK-----	1561
SPONGE	LLV---LS-PAQSGA-----GASFAAQD GLLLY ITYSGLINNKLLHIIK-----	1579
CAPITELLA	ELI---FN-SNNIHGVSTS-----VQCS PHGTLFY AAFKSVVNLNFVKSVE-----	1571
DANIO	GLL---LN-TITLSV-PLSGSLNPHFLSF SHGEYFY SLFQTSLNTELLRSVD-----	1586
MILII	SLL---LN-TMELSV-PLSGATQKNFIT FSHGEYFY SLFSETINAEELLKSLK-----	1583
BAMBOO	SLL---LN-TVELSV-PLSGASQRHFIS FSHGEYFY NLFPETINSELLRNLN-----	1582
XENOPUS	SLL---LN-TVILSV-PLPGTSQRNIIN FSHGGYFY TLFAETINTELLNNLD-----	1598
STERLET	DLL---LN-SIMLSV-PLSDTSQKNFIT FSHGEYFY SLFQETINSELLKNLD-----	1599
GAR	SLL---LN-TIMLSV-PLSGTSDKNFIS FSHGEYFY SLFQQTINIELLGLSD-----	1586
LATIMERIA	CLL---LN-RVTLSV-PLSGTSQRNFIT FFHGEYFY NLFMETTNSSELLRNLS-----	1587
CAECIL	SLL---LN-TVKLSV-PLSGTSQRNIIS FSHGEYFY SLFSETINTELLKNLN-----	1589
SNAKE	SLL---LN-TLMLFV-PLSGAAQESLIN FSHGEYFY SLFLEINRELLKNLE-----	1587
CANARY	SLL---LN-TVVLSV-PLSEASONQLMN FSHGGYFY TLFAETINQQLLKNLD-----	1578
OSTRICH	SLL---LN-TVVLTV-PLLGASRKNLVN FSHGEYFY SLFSETINEQLLKNLD-----	1548
GECKO	SLL---LN-SLMLS-PLSGVSRNLI FSHGEYFY SLFSDTINRELLKNLD-----	1587
TURTLE	SLL---LN-TMMLSV-PLSGTSQRSLIS FSHGEYFY SLFSETINQELLKDL-----	1587
ALLIGATOR	SLL---LN-TAMLSV-PLSEAAPRNLL SFCHGEYFY NLFSATINHELLKNLD-----	1545
PLATYPUS	SLL---LN-TVVLSV-PLAGTSQRNLI SFCHGEYFY NLFSATINTELLKNID-----	1580
TASDEVIL	NLL---LN-TVVLSV-PLSGTCQKNLI FSHGEYFY SLFSEVINTELLKNLD-----	1583
HUMAN	SLL---LN-PAVLST-ASLGSSQGSVIFSHGEYFYSLFSETINTELLKNLD-----	1576
MOUSE	SLL---LN-SAMLST-QYLGSSQR-NIS FSHGEYFY SLFSEVINSELLKNLD-----	1573
CRASSO2	MCI---LD-ESMVEGTAK-----GYSQ SHGELM FTAFKTTVSVHLAKAMA-----	1565
POMACEA	EGI---LD-IRIIQGLSL-----GIEY MLGDH FFTLFKTPISSHVAASS-----	1572
TRICHOPLAX	RYL---LD-ETK--L-----YGDSNSATATL GMTLY YTFNSNINAFKAVSN-----	1559
NEMATOSTELLA	RRA---VN-ILLIQM-----ICFL FS DGSSV GAVFY TTFQASINTYLIKNAQ-----	1569
PRIAPULA	SLL---FD-DTRLLGVSAK-----QT TKGSMFY STFGHEINNHLVGMAT-----	1582
SOFTCORAL	HCI---LN-KSCLADAKGS-----S TVGMV FYQTFHNTIEHLLIKNSS-----	1578
PISTILLATA	ESI---ME-DSND-----NPGSS CGCTFY RIFQTSINGFFIERAN-----	1597
HEMICHOR	SCL---MN-KTPVKTGRVD-----SSAGY CGLSFY SHFKVPINTQLAQHGQ-----	1602
BELCHER	DCV---MN-KTPLMTGGGK-----KS STFQGMV FFSTFKSCICQQLIKTCA-----	1602
STRONG	DCL---LE-TTPVVSSTRSLTSKLSASQ TSGLV FLTTYKQPIMDQLVKHGQ-----	1603
STARFISH	SCL---LD-KTALFSGRS-----S TSKGA VFYTTFFKTKLNGEMAVQAQ-----	1608

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70450.1
ARCHAEON	SDNLLHILSSSQHEPSRILLEDILSYISDQIACNPELVNYVVYTM-VP-----	1649
MUDCRAB	-----LIVTTLLELVKEGKGFLEVMVFNGLMLLNTLIRNSELRK--	1583
SCORPION	-----HFISLMNINIKSKTTVLKILVGI-LDSIGKVKEFRY--	1597
SPONGE	-----MAIDVLLKNAKTHPQQVSVILNLL-LEYVQKDFKINNNN	1617
CAPITELLA	-----KFVPLLMRHLEANGETLSSVLIGI-AESVISDRPLRK--	1607
DANIO	-----RSVPLLSSANQNPSMVSVLNGM-LDHSFRERSVRK--	1622
MILII	-----SAVTQLMRSASENPKMVSTVLNGM-LDQSFRDHTVRK--	1619
BAMBOO	-----SAVAQLMTSARENPKMVSAVLNGM-LDHSFRDHTVRK--	1618
XENOPUS	-----TIVVELMKSSLEDPKMVSCVLNGM-LDQSFRQRTIRK--	1634
STERLET	-----TTVAQLMKSAANPKMVSMVLNGM-LDQSFRERSVRK--	1635
GAR	-----STVPQLMSLAAENPKMVSAVLNGM-LDQSFRDRSVRE--	1622
LATIMERIA	-----TAVSQLMNSAAENPKMVGAIVLNGM-LDQSFRNRTVRK--	1623
CAECIL	-----TAILQLMKSSVDNPRMVGTIIVLNGM-LDQCFRDRTVRK--	1625
SNAKE	-----IAVLELMKSALDSPKMVSTVLNGM-LDQSFKDRATCK--	1623
CANARY	-----VFIIVRLMKSSISNPQMVGSIVLNGM-LDQSFRDRAVRK--	1614
OSTRICH	-----VIILQLMESSVSNPQMVGSIVLNGM-LDQSFRERTIRK--	1584
GECKO	-----VAVLHLKSSLDSPKMVGTIIVLNGM-LDQSFRDRAVHK--	1623
TURTLE	-----VAIVLQLMKSSVDSPKMVGTIIVLNGM-LDQSFRERAVRK--	1623
ALLIGATOR	-----VAIVLQLMKSAVDNPRMVGTIIVLNGM-LDQSFRERTVRK--	1581
PLATYPUS	-----TAVLELMKSSVDNAKMGVTIIVLNGM-LDQSFRDRIVRK--	1616
TASDEVIL	-----TAILELMKSSVDNAKMGVAIVLNGM-LDQSFRDRAVRK--	1619
HUMAN	-----LAVLELMQSSVDNTKMVSAVLNGM-LDQSFRERANQK--	1612
MOUSE	-----IAVSRLMESSSDNPKMVSTVLNGM-LDTSFRDRAVQK--	1609
CRASSO2	-----QAVPVLCEHAQKQCYRVMSILVMT-VDTVSKDKNLRK--	1601
POMACEA	-----DVVSLMNKATVDPHRVCNVLVAM-LENVAQDRRIRK--	1608
TRICHOPLAX	-----RCLPMILDLAASKSFMISGILSGL-LDFILDRGLRQ--	1595
NEMATOSTELLA	-----SHIPQLVSMATSYSSHVCSILNSI-LDQFNDRKTSRK--	1605
PRIAPULA	-----VLIIPKVLDRINNRESVVMTILTDL-LDQVGKDRETRK--	1618
SOFTCORAL	-----EHLPKILEYNRDEAQVVSSTVIAL-LDSMVKDKELRK--	1614
PISTILLATA	-----IHMANILMKAASSPFLVLSLNGI-LDQVIRDKILRT--	1633
HEMICHOR	-----EVVPLLLRHVVADSTIVSTIIVLNGM-LDHITNNRELK--	1638
BELCHER	-----ESLPVLLQQLTAEPVWVGSILHGL-LDHLAKDKTLRK--	1638
STRONG	-----DTVYELSNRVREDRGTIGMIYGL-LEHAVGNREIRK--	1639
STARFISH	-----KVIPLLVREGGKDVTVVSSVLNGL-LDYLTSSREVR--	1644

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70450.1
ARCHAEON	-----LLESRVNLTTL---SS---SAILQLAT LLA QVTAITSRLCEC----RA	1687
MUDCRAB	---KHSVKVQ AF LHHWSTYST EAG KSS---IHQESVLD LLSSL FLVDREGTMKAHCSAE	1637
SCORPION	---RYGKDIINS IMCQ WSRLQ QC LEESC-DIDLQNDIIT LLT KMFLIDSSFIKGNVN-YD	1652
SPONGE	NNKETVETLCTEL I SHWQDLSLWWEDGS--KDLKSAAVT LLQ KI I ALKPKLLLSAD--V	1673
CAPITELLA	---SHGKMVSRA I VSQWSSLSVW W SESTASLDTKMVAIT LLT KLMQIDSTVIIDVKN-KS	1663
DANIO	---SQGSQ LAEQ VLK GW DLLRPWWDGPAAT PESK TSVLS LLAK VLQIDSSVCSNTSH-PA	1678
MILII	---TQGVLLVSA VL TNWTRLES W SENS-SAESKMAVLT LLS KVLQIDSSVSFSSNH-EA	1674
BAMBOO	---KQGIYLVSA VL SNWAKLDS W SVKS-SPE SK MAVLT LLS KVLQIDSSVSFGNSH-DA	1673
XENOPUS	---QQGVKLVA VL ENWRRLDS W YKDS-P ESK MAVLT LLAK VLQIDSSVCFDINH-SA	1689
STERLET	---TQGSQ LVGG VLG SW TSLS W ASSS-SAESKMA ALT LLS KVLQIDSSVSFNTSH-LA	1690
GAR	---SQGRQLV KRV TQAWSSLS W SSPAST SESK MAT LLT S KVLQIDSSVCFNVNH-EA	1678
LATIMERIA	---QQGSQ LVDT VLQ NW TKLSS W IRSS-S PE SKMA ALT LLS KVLQIDSSVSFNPNH-AA	1678
CAECIL	---QQGV KM VIA VL Q NW KKLDS W DKNS-AP ESK MAVLT LLAK VLQIDSSVSSNAHH-EA	1680
SNAKE	---QQGVKLVA IL KN W GHLDH W AKDA-S PE SKMSVLT LLAK VLQIDSSVSFT-HH-EA	1677
CANARY	---QQGAKLVTA VL R NW EKLDG W WAKGS-SA ESK MALL LLAK VLQIDSSVSFNTNH-EA	1669
OSTRICH	---QQGVKLVT AV LR NW RLDS W WAKGS-AP ESK MAVLT LLAK VLQIDSAVSFNTNH-EA	1639
GECKO	---QQGVKLVA IL KN W VHLDN W TRDS-AP ESK MAVLT LLAK VLQIDSSVSFSTQH-EA	1678
TURTLE	---QQGIKLVT AV LR NW MRLDS W WAKDS-AP ESK MAVLT LLAK VLQIDSSVSFNTNH-EA	1678
ALLIGATOR	---QQGMKLVTA VL R NW MRLDT W WAKDS-AP ESK MAVLT LLAK VLQVDSSVSFNTKH-EA	1636
PLATYPUS	---QQGEKL VDA ILQ NW KRLDT W WAE DS -T PE SKIAVLT LLAK VLQIDSSVSSNTNH-AA	1671
TASDEVIL	---QQGMKLVAT IL Q NW KKLDT W WAKDS-V PE SKMAVLT LLAK ILQIDSSVSFSINH-GA	1674
HUMAN	--- HQGLKLATTILQH WKK CDS W W AKDS- P LE T KMAV LALLAKIL QIDSSVSFNTSH- GS	1667
MOUSE	---HQGLKLATA IL Q NW RK CDS W W APDS-AP ESK TTVLS LLAK M LQ IDSALSFDTNH-SS	1664
CRASSO2	---QISANVVTS V VEK W KS I SS W CLA-T--PE L HSMAM LLLTK L V LLDSKVVT D SSS-GH	1654
POMACEA	---SNGPRIVDM V ASK W HHLES W QAGS--SD LQ GLAV LLLTK LL V DSKAVLN V EK-SH	1662
TRICHOPLAX	---SKGIHIS KIL SS W NSL K C W W L TPD-AQ D LLQ I SVN ILN K CL T L DPQ F ATQ S ND-SS	1650
NEMATOSTELLA	---RYGS V CAS I VNS W EV F SS L W D MSS-S S EL K Q A LL EIM K L LLSD P K L ID P AK-PA	1660
PRIAPULA	---RYGSGVVNT VL Q C W GH LRDL W VATS-TP D R K D M LL MLLR K L LLIDSSVAT K G S H-SA	1673
SOFTCORAL	---MNGR K MT TV LL ES W ER LS H W W ENG G -E E L-K R ST A IL IRN IL I V D PK L SE V K---S	1666
PISTILLATA	---R NG SS F AV LL LN N W T S F E I F W R T H S -A M DL R H S IL MLL K M L I LD P AK V T D C N R-L T	1688
HEMICHOR	---K K GL T V H AA IL SN W SS L K S W W SE G A-T H D Q R S ST L IL L K L LQIDSK F AS D PTH-AA	1693
BELCHER	---K E GAAL C DS LL Q S W P K L AP W EE G A-L Q DS K ST A L TLLR K I L I IDS Q VSR D PAH-PA	1693
STRONG	---RYG M AI Y SA VL TQ W DT L SNL-----G Q ED D F M LN MLK V L QID F K F AT D PTH-PT	1688
STARFISH	---THG M SV H SA IL TQ W D I LM G GL K K G C-ST D LQ S F A LL MLR K L LQIDAK F VSD T TH-PV	1699

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70450.1
ARCHAEON	LR TYMLHELM LTFDNP KD VTKV VQCLSW LPLLLPGCTTSSSRSLSLVDMQGEAAELARVQ	1747
MUDCRAB	DAGVLK FYRRLLIEDKATLSMKNKALKLLPFFLT-----MSKQVSKSIS	1681
SCORPION	SNSIFFSFITLLQKSEMSLEFKICVLDLLPFFLC-----DAFLCKVQ	1694
SPONGE	SKPLVDMYTAMIGDEKLELNFKAVMIDLLPSFLL-----LSS-PEHQSQLK	1718
CAPITELLA	FYYVFKMFLGLISDKNNTLQFKTRVLDLLIFFCN-----LPAEENKQLE	1707
DANIO	FNAVFTTFTALLTDVSMPLNLKSQALIMLPFFTA-----LPSMPLEELR	1722
MILII	FAMVFHTYTTILT DSTLALNLKSQAMIILPFFAH-----LPEENLAVLR	1718
BAMBOO	FSMVFQTYTTILT DSTLALNLKTKAVIILPFFTO-----LPEENLVTLK	1717
XENOPUS	FAEVFKTYTSILTDQKLG LNLKSQAI IILPFFTK-----LTGEKLT ELK	1733
STERLET	FAVVFSTYTTLVTDSTLPLNLKSQALIILPFFTN-----LLGSTLADLH	1734
GAR	FEAVFTTYTALITDSALPLNLKNHGLIILPFFTN-----LPESTLAE LQ	1722
LATIMERIA	FPAVFNTYTTLLTDQTLALNLKSQAVIVLPFFTN-----LPEDHLADLK	1722
CAECIL	FSAVFNTYTSILTDQKLG LNLKSQAI IILPFFTN-----LTGDSLNDLK	1724
SNAKE	FPNVFNTYTCLLMDQKLG LHLKSQAI IILPFFTE-----LVGEGLHKLK	1721
CANARY	FTAVFNTYTSLLTDQNLG LNLKGQAVI IILPFFTN-----LTGEKLN DLK	1713
OSTRICH	FTAVFSTYTSLLIDQNLG LNLKSQAMI IILPFFTN-----LTGEKLN DLK	1683
GECKO	FSDVFNTYTSLLTDQNLG LNLKSQAVI IILPFFTN-----LVGERLV DLK	1722
TURTLE	FSAVFNTYTSLLIDRNLG LNLKSQAVI IILPFFTN-----LTGDRISELK	1722
ALLIGATOR	FFAVFNTYTSLLVDQNLG LNLKSQAVV IILPFFTN-----LTGERL KELK	1680
PLATYPUS	FSAVFNAYTSLLIDKKLG LNLKSQAVL IILPFFTN-----LTGDRLN DLK	1715
TASDEVIL	FLDVFTTYTSLLDDPKLG LNLKGQALI IILPFFTN-----LTGERLEDLK	1718
HUMAN	FPEVFTTYISLLADTKLDLHLKGQAVTLLPFFTS-----LTGGSLEELR	1711
MOUSE	FSEIFTTYASLLADTKLGLHLKGQAI IILPFFTS-----LREGSLENLK	1708
CRASSO2	FPEVFETYLSMLTEKKTLSVKCKILELLPFFAT-----LPEPHLKKLK	1698
POMACEA	FTTVFTSYCTILAEKKTNLAFKNRALDVLPFFAA-----VPDAKL---K	1703
TRICHOPLAX	FETVFNFFLSLLSGTSTSLAFKKYVLDLHFFLV-----SSDKRIREL R	1694
NEMATOSTELLA	FQIVLKMFTSVFDDKNLT LTFKSRAVELFPYFKN-----LPDNYQSQLK	1704
PRIAPULA	HRDVYDTYCCLLDVAGTSLAFKTRVMELH FYCE-----LPEQETTKLR	1717
SOFTCORAL	SRGMFKTYNGLLKDKTITLTVKIQCLELLPCFTS-----ATIPSEQTEAL R	1712
PISTILLATA	FPSLFEMYL LYLKDKSTTLAFKQVLELLPYFTK-----STEEYLRR LK	1732
HEMICHOR	FKPVFDMYLN MVTD SNTSLAFKSRVLEI LYFFTR-----IPEQELSL LQ	1737
BELCHER	FQPVF TMYLDMLTDSRSTLPFKSQVLDLLPFFTV-----LPQTQLAELK	1737
STRONG	FRPVFNQYLSMLRDSKKS LAWKTQVLDVLYFFAN-----VPEKEEKELK	1732
STARFISH	FSSVLEAYSFMLTDASTSLTFKAQVMDV LFFFTS-----LPDGEQTKLR	1743

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus “putative archaeon”

		RYG70450.1
ARCHAEON	EGLENLVSTR FPLDSSQL PVSSSQKEFLVILEAYLQAFQACGS VI MLPPLYPALREGK-	1806
MUDCRAB	ED LEMV SFKH FPMQ SSEFPVGGSRDRDYHQALSEILTAL ELSL SE LLKFI LQVFCNED-	1740
SCORPION	AAL NDL FTNH FPLY SS SELK PGSSQYNDYHLAFTKLLIAL EL TGN EMLLK FVIQIMCRES-	1753
SPONGE	G SLN R LV SLQ FPLT SS EL PAGGPLLNEYTNIIEKLCNS LV ASG SLV LE LI INIMCREV-	1777
CAPITELLA	S CLN Q FV ADCF PM SS LE FHAGSQQQKCYIT AL DRLL LAM ELSG SLM LL NLI ISVICKEV-	1766
DANIO	RA LES LVATH FPMQ SDEFPRGSLQCN NY MDCIRKFLEALQ LSQ S P LL LKL MARVLCRDK-	1781
MILII	HA LDQ FVA AHF PM K SDEF PK GT LK YNNYVDAIKK LDA LELSQ S P MLL KL MIA ILCRDS-	1777
BAMBOO	NA LN H FI ASH FPMK SDEF PK GT LR YNNYVDCVKK LDA LELSQ S P LL Q IL TEVLCRDN-	1776
XENOPUS	NT LDQ FVAS NF PM K SDEF PK GT LF FNNYVDCIKK FDA LELSQ S P MLL Q LM TEILCRDE-	1792
STERLET	NA LE V LV ASH FPMQ SDEF PK GT LR YNNYIDSIKK FDA LELSQ S P MLL KL MT GILCRDN-	1793
GAR	RA LE M LV ASH FPI SSDEF PK GT LR YNNYVDTIKK FDA LELSQ N P MLL KL MAE ILCRDK-	1781
LATIMERIA	NA LDQ LVAF NF PM K SDEF PK GT LK YNNYVDCIKK FDA LELSQ S P MLL RL MTE ILCRDS-	1781
CAECIL	NA LDQ LVAF NF PL K SDEF PK GT LK YNNYVDCVKK FDA LELSQ S T MLL KL MTE ILCRDT-	1783
SNAKE	HA LDQ LVAY NF PL T SDEF PK GT LK YNNYVDCVKK FDA LELSQ N ST LLE LMTEILCRDN-	1780
CANARY	NA LDQ LVAF NF PM K SDEF PK GT LK HNNYVDC TK KK FDA LELSQ S P MLL Q LM TEILCRDN-	1772
OSTRICH	NA LDQ L IA F NF PM R SDEF PK GT LK HNNYVDC TK KK FDA LELSQ S P MLL Q LM TEVLCRDH-	1742
GECKO	NV LDQ FVAF NF PL R SNE F PK GT LR YNN FVDC TK KK FDA LELSQ S P MLL Q LM TEILCRDH-	1781
TURTLE	NA LDQ LVAF NF PM K SDEF PK GT LR YNNYVDC TK KK FDA LELSQ S P MLL Q LM TEILCRDH-	1781
ALLIGATOR	DA LDQ LVAF NF PM K SDEF PK GT LR YNNYVDC TK KK FDA LELSQ S P LL Q LM TEILCRDH-	1739
PLATYPUS	NA LE Q F VAF NF PM N SDEF PK GT LR YNNYVDC TK KK FDA LELSQ S P MLL Q LM TEILCRDQ-	1774
TASDEVIL	LA LE K LV AS NF PM T SE HF VQ GT LK YNN YVDC TK KK FDA LELSQ S P MLL Q FM TEILCRDQ-	1777
HUMAN	RVLE Q L IV AHF PM Q S RE F PP G TP RF NN YVDC MK KK FDA LELSQ S P MLL EL MTE VLCREQ-	1770
MOUSE	HI LE K L IVC NF PM K SDEF PP DSL K YNNYVDC MK KK FDA LELSQ S P ML F Q LM TD ILCREQ-	1767
CRASSO2	RS LD RLVAD H F PI K ST DL PE SS PH FKDYIAAIDRLL TS LELSG SEM LL ELL ISIFCREP-	1757
POMACEA	DV LD GLVAD NF PL R S SEL TK G TPRFVDYISAIDKLL SAL ELSS SLV LE LL ISIFCREEG	1763
TRICHOPLAX	EH LD RMIVDK FPL KS A EFV VG SPDYNDYVACIDKLL AN L IK SG NLM LL EV LISVMCREK-	1753
NEMATOSTELLA	SC ID TLVTD NF PL K ST E FIP G SPRYNDYIATLDKLL VMT SG SLV LL Q VITAVLCREE-	1763
PRIAPULA	EN LD RMVAD FF PL R SS DF IV G SPKYHDYVAAMS QL LD VM EVSG STM LL RL VISIVCREP-	1776
SOFTCORAL	SAL K TL IA DN FPL SS K EF N EN N PKYS DY IAALDKIL SAL VISG SLM LF DL LLISIVCREE-	1771
PISTILLATA	E GL NA F V T NN I PL K ST E F V T G GPQYNDYVQ T IDKLL AAF VNS RS L IL LE V L IA IFCRER-	1791
HEMICHOR	GR LN R L IA DN F PL KS S EFV VG SPKYNDYVA AF GKIL SAL VISG SLM LL ELL ISIMCREP-	1796
BELCHER	AR LD RMVAD NF PL K S A EF P AGSSKYNDYV G AV TK LL SAL ELSS SLM LL ELL ISVMCREA-	1796
STRONG	SAL D LLVAN H F PL KS T D L EAGSPRYNDY I MA LN KIL TS LVMSG SLM LL EL I S ILCRDD-	1791
STARFISH	SAL D RLVAD NF PL N S S EF R VGSPKYIDY A GAL N KIL TAM VLSG NLM LL E IVISIMCRDE-	1802
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70450.1
ARCHAEON	QHIIYYQSF ^I KIVISS ^V PKSLPSLPPTDTMEHSGSEHLYTEVKHICNFCLEVIYNVYQD---	1863
MUDCRAB	KHRYEEAF ^N ESIE ^K FIKRQQVS--KQ-----IDTLRFVYDMYAN-QS	1779
SCORPION	THLLEENIQKCLKKLCKRTDSN--KE-----RLIAEVPLKMFLE-DE	1792
SPONGE	RHVCEEKI ^Q TSLHQ ^F ISKLSED---G-----VDALKFVYEMFKN-DK	1815
CAPITELLA	KHTHENAI ^Q SAF ^Q R ^F IKRLPKD--KH-----KLALDVPYKIFSQ-EG	1805
DANIO	KHIMEELF ^Q ACF ^Q KIAHQSYLG--KQ-----VLLLSSTYQSFQA-KE	1820
MILII	RHVMEEGF ^Q VC ^F QRLAKTGSCE--KQ-----VALLEAVYGMFEN-EG	1816
BAMBOO	RHVMEEF ^Q IC ^F QNI ^A KRGTC--KQ-----VALLEAAYEMFRN-EE	1815
XENOPUS	RHFMEELF ^Q SSF ^K KVIKRSSCD--TQ-----VILLNTLHNMFKS-ES	1831
STERLET	KHVMEELF ^Q TC ^F KRIARRGSC--KQ-----VSLLDTVYQMFQ-DE	1832
GAR	KHVTEELF ^Q AC ^F KRIARRSGC--RQ-----VVLLETVYEMFQA-GE	1820
LATIMERIA	KHCLEELFL ^R CF ^K KIVRRGSCD--RQ-----VTLLDTPVYKMFQD-EG	1820
CAECIL	KHFMEELFL ^T S ^F KRIARRGNCD--KQ-----VALLETVHDMFKT-EN	1822
SNAKE	KHIMEELF ^E INL ^K RIAKRGSC--RQ-----VLLLDTPVHQMFS-ET	1819
CANARY	RHFMEDLF ^Q AS ^F KRISRRSPTD--KQ-----VLLLDTPVHQMFS-EE	1811
OSTRICH	RHFMEGLF ^Q AS ^F KRISRRNSD--RQ-----VLLLDTPVHQMFS-ED	1781
GECKO	RHIMEEQF ^E IS ^F IRIARRGSCY--KQ-----VLLLDTPVHQMFS-ET	1820
TURTLE	RHFMEDLF ^Q TS ^F KRISRRSSYE--KQ-----VLLLDTPVHQMFS-EA	1820
ALLIGATOR	RHCMEDLF ^Q TS ^F KRVIKRSDCN--KQ-----VLLLDTPVYKMFQS-ES	1778
PLATYPUS	RHFMEELF ^Q MS ^F KRIARRSGSA--KQ-----VALLEAVHGMFLR-DD	1813
TASDEVIL	RHVIEELF ^Q TF ^F QRISKRSSA--TQ-----VALLDTPVHRMFQK-DD	1816
HUMAN	QHVMEELF^QSSF^RRIARRGSCV--TQ-----VGLLESVYEMFRK-DD	1809
MOUSE	RHIMEELF ^Q TF ^F KRIARQSPCV--TQ-----LNLESVYTMFRK-AD	1806
CRASSO2	KHVYETK ^I LES ^I NR ^F TRRVPAA--KQ-----KSMVDVAYNIFCQ-EK	1796
POMACEA	RHVHEDAI ^Q QSLN ^T FTARLPAE--KQ-----KDALDVPYKIVFC-ES	1802
TRICHOPLAX	KHAYEEQ ^I QKSL ^L LFISS ^L IPKDA-----LGALDVPFKMFVD-DK	1792
NEMATOSTELLA	RHVHEEE ^I QKSLA ^A FIQRLAPSSSLV-----KGAVDVTYRIFTN-ER	1804
PRIAPULA	KHAMHDQL ^Q TSLSR ^F IHR ^L SAD--KQ-----KLAADSGYSILAE-EG	1815
SOFTCORAL	SHSHEEE ^I QIQ ^F AK ^F IKRLKLQ--QA-----RKALDICFDVFTKKDT	1811
PISTILLATA	QHVHEDQ ^I QSF ^I AF ^I QRLHPEPDQA-----KAAMDVCLSIFFN-ER	1832
HEMICHOR	KHVCEDE ^I QASL ^I TFIKHLPAD--KQ-----KPAVDVAFDVFHK-EN	1835
BELCHER	KHVMEDE ^I QTSLSR ^F IKGMGAD--RQ-----KPALDIPYGIFRR-EG	1835
STRONG	KHSYEDK ^I QGAL ^S FAKRLPSE--KQ-----SAAANIPFEIFKQ-DK	1830
STARFISH	KHAYEDE ^I QESL ^A AFIKRLPEE--KQ-----TAAFVAVYQIFCQ-EN	1841
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus “putative archaeon”

		RYG70450.1
ARCHAEON	---VPIKRILLEFLLLPPTLLSLSSKNMVVLFSLGYHRGLQIRMSSVSSDHSI IKVLHDI I	1920
MUDCRAB	HLKQNLRYNIMEKVLIIPLLQLSDLTVTVSFSIDV-----IKPVMAGM	1821
SCORPION	LYPDMRIHIIIEKVFRVILGMISKITLKYFFIDH-----IKEIMQIV	1834
SPONGE	DFPVAAVKIGIGERLCVPLFTECSSAVLLEFFVLK-----ISDVMCIM	1857
CAPITELLA	RFTNNQRRRAACEKVSLSLMRLVHSSALTEFYCEH-----IKEIMKII	1847
DANIO	VPSNFMLMGLIDRVLLPLASHCSPQALSQFFISN-----IADIMTTL	1862
MILII	GLSNIARQSVMDRSLTLITHCSLDALKEFISKI-----IKDAMGIL	1858
BAMBOO	MLPNATRQFAMDRSLTLIGHCSPDALREFFCKI-----VKDAMEIL	1857
XENOPUS	LMLNGTLQSLIDRCLLTLWNCSLDAMISFFTNI-----ISLAMDTL	1873
STERLET	LHSNTARQAVLDRSLTLTLHCSSDALKEFFCTT-----VGDIMGTL	1874
GAR	LASGAMRQAVLDRVLLTLVLHCSSDALRGFFCKT-----IASVMETL	1862
LATIMERIA	LLSNTTRQAIMDRFTFLTIMLNCSIDALKEFLCKN-----ILDVMGTL	1862
CAECIL	LWSNTTRQTIVDKSLLLIWHCSLDALKEFFCKI-----IHTMDTL	1864
SNAKE	LHSNITRQAYVDRCLLILLHCSLDALKEFLSKI-----IEAMDTL	1861
CANARY	LLSNAARQAFVDRSLTLLWHCSLDALRVFFGKI-----IVEAMDTL	1853
OSTRICH	LRSNVTRQAFVDRSLTLLWHCSLDALREFFGTI-----IVQAMDTL	1823
GECKO	LLSSATRQAYVDRSLTLLHCSLDALDDFFCKI-----IVEAMDSL	1862
TURTLE	LLSNATRQAFVDRSFLTLLHCSLDALKDFFSKI-----VLEAMDTL	1862
ALLIGATOR	LLSNVTRQAFVDRSLTLLLYCSLDALKEFFSKI-----VVEAMDTL	1820
PLATYPUS	HLSSSTRQAFVDRSLTLLHCSLDALKEFFYRI-----IVGAMDML	1855
TASDEVIL	-LSNIPRLACVDRCLLTLWHC SLAALREFFSSI-----IVEALDVL	1857
HUMAN	PRLSFTRQSFVDRSLTLLWHCSLDALREFFSTI-----VVDAIDVL	1851
MOUSE	LPSNVTRQAFVDRSLTLLWHCDLDTLKEFFSRI-----VVDAIDVL	1848
CRASSO2	LYPGEVRRTTIEKVALPILRLVHKSALLEFFTDH-----MGDLRRTV	1838
POMACEA	GFQDMIRRTTLERVCLPILRCVHKAALIEFFLDH-----ILDLMRIV	1844
TRICHOPLAX	SYRPDIRRAAIEERVCLPMLQKASLKITKDFYVSH-----IKEIMDII	1834
NEMATOSTELLA	DHTSNVRLAVLDRVSVTLNASKAGVSEFFSSH-----VKEIMEII	1846
PRIAPULA	NFPGEIRRSCLDNVLLLRQCCHHAVVEFFRCH-----LVEIIGII	1857
SOFTCORAL	EYRNLTRRAAIDKVCCLVLLRASSTSVFREFFYVDH-----IKNIMEII	1853
PISTILLATA	DYQTHSRRAVIERICITFLKTTSTARRAFYQDQ-----IQKLMSVL	1874
HEMICHOR	VYPNDIRRAALERVGLPLLRLVDIPTLSTFFISH-----VNQIMNTI	1877
BELCHER	SFPNEIRRSALERVCLPMLRLVHPAALTEFFTDH-----IREIMDII	1877
STRONG	RYSKEIRKAAIQRVCIPLLRQASRDATVTFYKGH-----IHDIISVL	1872
STARFISH	SFSKEIRRAAIERVCIPLMRLAGVKALSSFFKEC-----IKNIGGII	1883
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70450.1
ARCHAEON	AGDIFPANMSDETLTLLSHVYVMVTVAYKMLSLLYDHCYVGDVKL---TLTAAFVHGDMSNTV	1977
MUDCRAB	SLTIQ--GRS-DEQQRLLVTKIGSFKILQVIFSRPRLPRERIFNPGSEINAAYQPSD-----	1873
SCORPION	KSKRK--SS----NEIQLVSKIGAFQLIEILYTYLSKEEVS-KESQINC-----	1876
SPONGE	EAKLA--RVTDPKLECLVHKSCCFQFIEILYTRLPSSLISSMESTVNTAYCNGS-----	1910
CAPITELLA	EAKPT--KAPEHAFAEAQLTSKIGCFELLEVMYSRLPNTDVNSKDSSINKSFCSFK-----I	1901
DANIO	QTRFT--KSVESVFESQIMMKIGCCKLEVLYSRLPKEEVYSKNSAINQAFCGTG----C	1916
MILII	QSRFT--KTSESSFDNQLTRKIGCYKLELVYIIRLPKDDIYSEDSKINRAFHSSS----N	1912
BAMBOO	QSRFT--KTNESSFDNQLTKKIGCYKLFVEMYTRLPKNDVYTDGSKIQAFAHSAG----N	1911
XENOPUS	KSRFT--KVPEAAFDSQITKKWGYKMLEVQYSRLSKDEIYST---VNNAYHVSS----K	1924
STERLET	QARFT--KSSESTFETQLTKKNGCYKLEVLYSRLPKEDVYSKESLINQAFCRPN----K	1928
GAR	QARFT--KLNEAMFEGQLIKKNGCYKLEVLYSRLPKEEVYSKESKINQGF CGPS----R	1916
LATIMERIA	QARFT--KSNESAFDTQVTKKTG CYKLEVMCSRLPKDDIYSEQSRINQAFHGSC----S	1916
CAECIL	KGRFT--KSNELAFDAQIMMKMSYYKMLEVMYSRLTKEDIYSKGSRINQAFHGSS----N	1918
SNAKE	KSRFT--KSNETSFETQLIKKISYYKILEVMYSRLSKEDVHSKDSRINQVFORST----H	1915
CANARY	NSRFT--KSHEFTFDTQVTCKMGYYKLEVMYSRLSKEDVYSKDSKINQAYRGSMS----S	1907
ONSTRICH	NSRFT--KSNESTFDTQVTCKTGYYKMLEVMYVRLSKEDVYSKDSKINQAYCGSI----S	1877
GECKO	TSRFT--KSNETMFDTQVTCKMSYYKILEVMYSRLSKEDVYSKDSRINQAF LRST----C	1916
TURTLE	KTRFT--KSNESAFDTQVTCKMGYYKILEVMYSRLSKEDIYSKDSRINQAYQGST----N	1916
ALLIGATOR	KSRFT--KSNETVFNTQVIKCKMGYYKILEVLYSRVSKEDVHSKDSQINQAYQGT----N	1874
PLATYPUS	KSRFT--KSNESTFDTQVTCKLGYKMLEMMYSRLPKDDVHSKESRINRAFHGSS----V	1909
TASDEVIL	KSRFT--KLSESTFDTQVTCKLGYKMLEVLYSRLPKDDVHSKESRINQV FHGSS----I	1911
HUMAN	KSRFT--KLNESTFDTQITCKMGYYKILDVMSRLPKDDVHAKESKINQV FHGSC----I	1905
MOUSE	KSRFT--KLNEFTFDTQITCKMCYYKMLAVMYSRLPKDDVHSKEAKINQAFHGSR----V	1902
CRASSO2	EAKLV--KGS--GLENQLTSKLC CFQLLELMYGRLSKEEVFGKSSVINKKFCEVKSVM--N	1892
POMACEA	EQNLA--KGPESILKTQLTSKVCCFQLLEVMYSRLSREEVNSLSSEINKKVCFGK-----	1897
TRICHOPLAX	ETKLV--KTA--DLENQLISKLGSYKLMKLMYSKLSKQDVNTAESSIVKAYTGRP-----	1885
NEMATOSTELLA	EAKQL--KTYDPGFESQLVSKMCAFMI EVLYSRLGKAE LNSPQSSINLAYCPN-----	1898
PRIAPULA	EAKVV--KLPERQYESQLISKICSLKLELMYACL PKEDVY GKDAALGQVFLASR-----	1910
SOFTCORAL	ETRFS--KATDSVFESQLVSKLC CFKLLALLYARLEKTDVSSMESRINRAYNN-D-----	1905
PISTILLATA	EAKEL--KPTDPNFESQVTSKLC CFKLV EILYSQFSKSELNTPQSKVNKIYCRDS-----	1927
HEMICHOR	EAKQI--KVPESFETQLVSKIGCFELMEVLYSRMTKEELNTPQSKVNKIYCRDS-----	1930
BELCHER	GAPQT--KAGEASLRTQLTNKLC CFQLLETMY SRLPKEEVNTPPSRIVRAYKGEE-----	1930
STRONG	EARLT--KNPVP AFENQLVSKICYFELIEVLYSRLSKDD LNSKDSALNREYRHGN-----	1925
STARFISH	DAKTI--KAPETVFQNLVSKTCCFQLVELMYSRLVKEDLFSMDSA INKAYTN-D-----	1935

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus “putative archaeon”

		RYG70450.1
ARCHAEON	NIKGSEL--TSAVLKVAHKFVVRTQMSSIPNYYAYSIVSELKETLFFELYAAAFSCLVTVI	2036
MUDCRAB	-TSGKEL-TKDVLRRQSSKVAKGLRHDQ-----TQAEFRRLCACAAYNTLI	1922
SCORPION	-SYGKEL-TREATGFAIARKEKLENGES-----ISKFCRKYCCAAYNAVIAI	1925
SPONGE	PQTGKEL-TQAITKCCHGAKSEDLHGDR-----THYETRRQYHCHAYNTLM	1960
CAPITELLA	PDTGKEM-NLTITKVSNAKGENNMGET-----LLIPLRRALHCAAYNTLIA	1951
DANIO	-AEGNEL-SKNLLKSCFEAFTENMTGEM-----VLELRRQFHCAAYNCAIAL	1965
MILII	-MEGNKLLSKSLLKLCYDAFTENMTGEK-----QLLEKRRQYHCAAYNCIM	1962
BAMBOO	-IEGNKL-SKTLKSCYDFTVENMTGET-----QLLEKRRQYHCAAYNCMIA	1960
XENOPUS	-PEGNEL-TKALIKLCYDFTVENMCGET-----QLLEKRRQYHCAAYNCAIS	1973
STERLET	-AEGNEL-SKSKLLKSCFDFTVENMAGET-----QLLEKRRKYHCAAYNCAIT	1977
GAR	AAEGNEL-SKTLKSCFEAYTENMAGET-----QLEERRQYHCAAYNCAIAV	1966
LATIMERIA	-AQRNGL-SKTLKLCYDEFTEENMAGET-----QLLEKRRQYHCAAYNCAIAV	1965
CAECIL	-AEGNEL-TKILVKSCYDSFSEN	1967
SNAKE	-VEGNEL-TKLLIKSCYDAFTENMSGET-----QLEENRRQFHCAAYNCAIAV	1964
CANARY	-VEGNEL-TKTLIKSCYDAFTENMAGES-----QLLEKRRQYHCAAYNCAIAV	1956
OSTRICH	-VEGNEL-TKTLIKSCYDAFTENMAGES-----QLLEKRRQYHCAAYNCAIAV	1926
GECKO	-VEGNEL-TKTLIKSCYDAFTENMTGET-----QLLEKRRQYHCAAYNCAIAV	1965
TURTLE	-VEGNEL-TKTLIKSCYDAFTENMAGES-----QLLEKRRQYHCAAYNCAIAV	1965
ALLIGATOR	-VEGNEL-TKMLIKSCYDAFTENMAGES-----HLLGKRREYHCAAYNCAIAV	1923
PLATYPUS	-IEGNEL-TKTLIKSCYDAFTENMAGET-----QLLEKRRQYHCAAYNCAIAV	1958
TASDEVIL	-VEGNEL-TKTLIKLCYDAFTENMAGET-----QLLEKRRLYHCAAYNCAIA	1960
HUMAN	-TEGNEL-TKTLIKLCYDAFTENMAGEN-----QLEERRLYHCAAYNCAISVIC	1954
MOUSE	-AEGNEL-TKTLKLCYDAFTENMAGES-----QLLEKRRLYHCAAYNCAISL	1951
CRASSO2	VDTGKEM-TQVIMRTAHEAKGEDV	1942
POMACEA	PETGKEM-TQKIIKAANNAKSEDT	1947
TRICHOPLAX	TEDGKEI-TKSITKAAHACKSDDL	1935
NEMATOSTELLA	DNTGKEL-TKAITKSAHAAKSEDM	1948
PRIAPULA	PAGSKEL-TPVITRLCYDACREDM	1960
SOFTCORAL	VKTGKEL-TMAITKAAHAAKSEN	1955
PISTILLATA	VKTGKEL-TLAITKAARAASIED	1977
HEMICHOR	VKSGKEM-TMALT KIAHAAKGED	1980
BELCHER	VKAGNEM-TTAITKFGHAAKSEDL	1980
STRONG	VEKGNEM-STALT KAALGARNED	1975
STARFISH	VKTGKEM-TQALT KAACHAAKSED	1985
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70450.1
ARCHAEON	TQSEEEKFYDNFIFSQKPSEDIY--DHILHYP---PLDVENDASLSTFTRKFDDARLSNN	2091
MUDCRAB	VKDDLKFYTSLLFNANPTKGEAIWECLIDCNRNLQFDIEINLNPQ--SKRRFVAVR----	1976
SCORPION	TQTDSKFYSTFLFQENFAKGEYIWENIIDLNKEYTFPIELDT-IE--RRRKFISVR----	1978
SPONGE	TQSKPQFFVGFLEKEDVVKGQLLWNNIIDCEKKYEFQVDFEAPLK--RRKQITSIR----	2014
CAPITELLA	TQKEKKFYTAFLFTENPAKNQLHWNINVDQDVVYEFPLEMENPIE--RRKKFVSIR----	2005
DANIO	SFNETKFYQGFLFTEKPKDNQFIFDNLIDSQRVYNFPIEIDVPIE--RKKKYVMIR----	2019
MILII	IFTEAKFYQGFLFSEKAEKNIFIFENLIEAHRTYNFPVEIEVPLE--KRRRFISIR----	2016
BAMBOO	IFTEAKFYQGFLFSEKPEKNIFILENLIDSQRAYNFPVEIEVVE--KRRRYFAIR----	2014
XENOPUS	VFSELKFYQGFLFTEKKEKNLLIFENLIDLQRNYTFPIEVEVPME--RKKKYFAIR----	2027
STERLET	SFNETKFYQGFLFSEKPEKNQFIFENLIDAKHTYSFPVEIEVPLE--RKKKYVAIR----	2031
GAR	SFNETKFYQGFLFTEKPEKNQFIFENIIDAQOTYRFPVEIEVALE--RKAKYVAIR----	2020
LATIMERIA	IFTESKFYQGFLFSEKPEKSLYILENLIDMKCSYNFPIEIEVPIE--KRRKYVAIR----	2019
CAECIL	AFTDAKFYQGFLFTEKTEKNLLIFENLIDLQRQCYTFPVEVEVPLE--RKKKYVAIR----	2021
SNAKE	VFENENKHYHGFLFTEKPKDNLLIFENLLDLQHRYSFPPIEIEVPLE--KPKRYITIR----	2018
CANARY	VFTESKFYQGFLFSEKPEKNLLIFENLIDLKREYTFPVEIEVPLE--RKKRYIAIR----	2010
OSTRICH	VFTESKFYQGFLFTEKTEKNLLIFENLIDLKRQYSFPVEVEVPLE--RKKRYIAIR----	1980
GECKO	VFNESKFYQGFLFTEKPKDNLLIFENLLDLQHRYSFPPIEVEVPLE--RKKRYIAIR----	2019
TURTLE	VFTESKFYQGFLFTEKPEKNLIFENLLDLKHRYSFPVEVEVPM--RKKRYITIR----	2019
ALLIGATOR	VFTESKFYQGFLFTEKPEKNLLIFENLIDLKHQYSFPVEIEVPM--RKKRYIAIR----	1977
PLATYPUS	VFNETKFYQGFLFTEKPEKNLIFENLIDLKRCYTFPVEIEVPM--RKKKYIAIR----	2012
TASDEVIL	VFSEMIFYQGFLFTEKPEKNLIFENLIDLKHQYTFPVEVEVPM--RKKRYIAIR----	2014
HUMAN	VFNELKHYQGFLFSEKPEKNLLIFENLIDLKRRYNFPVEVEVPM--RKKKYIEIR----	2008
MOUSE	VFNELKHYQGFLFNEKPEKNLIFENLIDLKRCYTFPIEVEVPM--RKKKYIEIR----	2005
CRASSO2	TQTDAKFYTAFLFKEDEAKGQFVFDNLLDKDKAYVFSSELKAPLS--RKKQYVSIR----	1996
POMACEA	VQNEHKFYKGFLLQDNTSKGQFLLENIVDRDQKYEFPLELESQFE--RKKKFVAIR----	2001
TRICHOPLAX	TQTEMKHYTVFLFTENVARKQFLWENLIDMEREYAFIEISYQDK--QKTTFRSLR----	1989
NEMATOSTELLA	TQTELKHYTAFLFNENPVKGFLLDNLIDTDRKYEFEVELSSTPLE--RKKQMTSIR----	2002
PRIAPULA	TKTEPVYSSLLLQENPAKGQLLWNNIIDCHRRYGFDRSAPLQ--RKRQFVAIR----	2014
SOFTCORAL	TQTLLKHYNGFLFSEDLKSGQFLLDNLDVDCSTKHLFEMELSAPLD--KRTLLTSIR----	2009
PISTILLATA	TQTDLKHYVAFLFSENPIKQQLLDNLDVDCNRTYTFEVELSAPLE--RRKQFRMQA----	2031
HEMICHOR	TQNDIKHYNGFLFAENHAKGQFFLDNLDVDADKVYHFEIEMESPME--RKKKFVAIR----	2034
BELCHER	TQTDKHYTAFLFQENTAKGQFLLDNLDVDPKKEYGFAIEMDAPVE--RKKRFVAIR----	2034
STRONG	VQDNIKHYNAFLFSENHAKGQFLLDNLDVDPKKEYGFAIEMDAPVE--RKKRFVAIR----	2029
STARFISH	TQTDIKHYNAFLFSENTAKGQFLLDNIIIDITKNYSFEIEMNAPME--RKKRFVSIR----	2039
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70450.1
ARCHAEON	IYSQSDWAMRNREVNNAVVTVQRLCTQAKKRLGKGGYASQYLQSCMLSSSQAVQSVAAPLQ	2151
MUDCRAB	-----KNLKEANQS-SGKG-----AAGTVQYLASHYLDDSSL-----	2007
SCORPION	-----HENRELNSN-KTLN-----FASSLKYAPSQYLSLSSL-----	2009
SPONGE	-----DDLKQSTAA-GNSS--GSPSSSPSTRPRYISSQYLSLSSL-----	2051
CAPITELLA	-----TSVRDVDPD-DEPT-----GPASSVHYLASQYLAGSSL-----	2037
DANIO	-----KEVSG---E-NGDA-----PVYLSSQSYMADSSL-----	2044
MILII	-----KEAREAGDG-DSGE-----PQYLSSQSYMADSSL-----	2044
BAMBOO	-----KEARESAEG-DSDE-----PHYLSSQSYMVDSSL-----	2042
XENOPUS	-----KEARDASST-ESDE-----PSYLSSQSYMADSSL-----	2055
STERLET	-----KEARQGEG-DSDE-----PHYLSSQSYMADSSL-----	2059
GAR	-----KEAREAGDR-DAEE-----PHYLSSQSYMADSSL-----	2048
LATIMERIA	-----KEARGSTIG-DLDE-----PQYMSSQSYMADSSL-----	2047
CAECIL	-----QEARNTANG-ESDA-----PHYLSSQSYMADSSL-----	2049
SNAKE	-----KEARQTMSG-DSAE-----PRYLASASYMVDSSL-----	2046
CANARY	-----KEARDAGNS-SQDE-----PKYLASSSYMMDSSL-----	2038
OSTRICH	-----KEARDSGNG-NEDE-----PKYLPSASYMMDSSL-----	2008
GECKO	-----KDAREAMSV-DSAE-----PHYLASASYMADSSL-----	2047
TURTLE	-----KEARDAVNR-DSDE-----PQYLPSASYMVDSSL-----	2047
ALLIGATOR	-----KEARDTVNG-GPDE-----PQYLPSASYMVDSSL-----	2005
PLATYPUS	-----KEARDSVND-NSDE-----PHYLSSLSSMADSSL-----	2040
TASDEVIL	-----KEARDAANG-DSEG-----PHYLSSLSYMADSSL-----	2042
HUMAN	-----KEAREAAANG-DSDG-----PSYMSSLSYLADSTL-----	2036
MOUSE	-----KEARDAANG-ASGS-----PHYMSSLSYLTDSL-----	2033
CRASSO2	-----NEVKESNSQ-NGEA-----DEGESSLHLASQYLADSSL-----	2029
POMACEA	-----SEMQEKQS---D-----KDGAISSYHLASQYLTESSL-----	2030
TRICHOPLAX	-----EQSRSSVSS-ESADE--ADSGIAMAPSYHLSSQYLADSSL-----	2026
NEMATOSTELLA	-----INARVQS---DQVEE--AL--SQGRSVRYLSSQYLADSSL-----	2035
PRIAPULA	-----TAVREIDRD-ADGQ-----GAPLPSVHYLASQYLADSSL-----	2047
SOFTCORAL	-----CEARATRMN-SSEN-----YEHGVSLRYLSSQYLADSSL-----	2042
PISTILLATA	-----R---IPSPK-ENSL--EESAGRTGLSIHYMYSQYLADSSL-----	2065
HEMICHOR	-----KEVRDASEE-DDLQDSAVGL-YGTGGVRYLSSQYLADSSL-----	2072
BELCHER	-----QELRGQDSP-EAG-----SSRY-MQSYLAGSSL-----	2060
STRONG	-----TQARETNTP-EES-----GYVSGPAHYLSSQYLSLSSL-----	2061
STARFISH	-----NQIQDQTVAG-SSSQQSDSGIEMSGYTGRYLSTQYLANSSL-----	2078

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70450.1
ARCHAEON	TSSIKPPSMTRVEGDYTL LSQY DYTNMLGNGGGSSATDYRI-----A	2192
MUDCRAB	-----RED LSQF DFSNSVVLAMSQREDNQYR-----	2033
SCORPION	-----SDD VSQF DFSSSELAFSQDMKNKNRKEEI-----DS	2040
SPONGE	-----STD VSQY DFTLPHHHQYGSVGGGAST-E-----SSSI-D	2083
CAPITELLA	-----STD VSQF DFGSSMVSSADSSFDNQRSRE-----SSI	2068
DANIO	-----SEEMS QF DFSTGVQSFYSYNSQNPSTSGV-----SSSSRMRE	2078
MILII	-----SEEMS QF DFSTGVQSFYSYNSQDPRGH-----AVRSRRKE	2078
BAMBOO	-----SEEMS QF DFSTGVQSFYSYSSQDPKVS-----VLRTRKTE	2076
XENOPUS	-----IEEMS QF DFSTGVQSFYSYSSQSKMLS-----QSASRKKE	2089
STERLET	-----SEEMS QF DFSTGVQSFYSYSSQDPSAR-----AARGRRRE	2093
GAR	-----SEEMS QF DFSTGVQSFYSYSSQDPSTR-----PMPSTRRD	2082
LATIMERIA	-----SEEMS QF DFSTGVQSFYSYSSQNRAAA-----VVHSRRKE	2081
CAECIL	-----REEMS QF DFSTGVQSFYSYSSQDPTAA-----QFHSRKRE	2083
SNAKE	-----SEEMS QF DFSTGIQSFYSYSSQEDPTSS-----GSHIRKKE	2080
CANARY	-----SEEMS QF DFSTGVQSFYSYSSQDVTAS-----STRFRRKE	2072
OSTRICH	-----SEEMS QF DFSTGVQGFYSYSSQDVTAS-----SPRFRRKE	2042
GECKO	-----SEEMS QF DFSTGVQSFYSYSSQDPTAS-----ASHFRRKE	2081
TURTLE	-----SEEMS QF DFSTGVQSFYSYSSQDPTAS-----SIHFRRKE	2081
ALLIGATOR	-----SEEMS QF DFSTGVQSFYSYNTQDPTAT-----SARFRRKE	2039
PLATYPUS	-----SEE ISQF DFSTGVQSYSYSSQDVKST-----GYHFKRRE	2074
TASDEVIL	-----SEEMS QF DFSTGVQSYSYSTQDSKAT-----VVHFRRRE	2076
HUMAN	-----SEEMS QF DFSTGVQSYSYSSQDPRPA-----TGRFRRRE	2070
MOUSE	-----SEEMS QF DFSTGVQSYSYSSQDRKPT-----TGHFQRRE	2067
CRASSO2	-----HED LNQY DFATATPQ--MSEKSPREKVLTVRKS-----SYTDEEDD	2067
POMACEA	-----SED LSKY EFTVSGSAQNTSGIPKTKASLRKNS-----SY-----G	2065
TRICHOPLAX	-----NEE ISQF DFNSSTVQGYSENNSIKQIPT-----RE	2056
NEMATOSTELLA	-----SEE VSQF DFSTPVQVNIINYLKR-----	2058
PRIAPULA	-----SED LSRY DFNVSTQIRERGDPAERKPE-GEAEQEEEEAMDVNEE	2092
SOFTCORAL	-----CEE VSQF DFSTPIQALSQSESTEQD-IA-----GGE-----N	2073
PISTILLATA	-----SED ISQ CDFSSPIQVHSGTEA--RQPLY-----KLNE	2095
HEMICHOR	-----SEE ISQF DMNTGCLYWHTNLCMSIFACMLHVLPH-----FVFSL	2112
BELCHER	-----SED ISQF DFSTSGTQVKHSQTFSSSTQERYSQASQG---SSRLQARQQ	2103
STRONG	-----SED VNQF DFSSSVRHFSSM-ESQRDGGSQGSQSRPGSMASRQD	2106
STARFISH	-----SED IQQF DFSGGVQQFNASI-DKDQSLSQRSSVPH---IKKYSNE	2120

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70450.1
ARCHAEON	FPNSAAVVAG-WDDQQVVL EM NHF NS IHIMGTLVRAIQRM Y VLFK-----EKW I ANTATL	2246
MUDCRAB	---IAASND E TGELLRM NF EQSD Y NEHEV M ANLTA AI YH M VDAKIMMLHKEDSTPSAA E I	2090
SCORPION	NPSNEAKDDDLVSNIT V EL E IDD L NQHECM NS L T M L VQ H MEKIQLL-----SSS--PKE I	2093
SPONGE	EDSGNSQEASSYVVSEE Q LE E DDL N IHEC M TP L M K L L D H M I INKITPAPSGD----S P E M	2139
CAPITELLA	EVPDVVLKEHY-----I E M E MDAL N Q H PC M AAL S AL Q H M K L NQIT P EV E K G SK--P S S M	2121
DANIO	-RKEVLSQDET-----V E LE M DE L NQ H EC M AN M TAL L R H M Q R N NIT P K V E E G V R--P S D L	2130
MILII	QAE L SVVQSDI-----M E LE M DE L NQ H EC M P A M I AL I N H M Q R N NIT P Q V E E G K T--P Q E L	2131
BAMBOO	WTES N IM L NDI-----V E LE M DE M NQ H EC M AT M TAL I K H M Q K T NIT P K V E E G K T--P H E L	2129
XENOPUS	QIT E G K T F DDV-----M E F E M D E L NQ H EC M A A M T G L I K H M N R S E IT P K V ED E D A S--P Q E L	2142
STERLET	-R V ES L VQDDV-----V E LE M DE L NQ H EC M A S M T AL L N H M Q R N NIT P K V DE G T V --P A D L	2145
GAR	-G A E A ALQDDV-----V V LE M DE L NQ H EC M A S M T V L I N H M Q R N N IT P E V E E G T V--P S D L	2134
LATIMERIA	-R T ES V VQDDV-----M E F E M D E L NQ H EC M A A M T AL I N H M Q R N KIT P Q V E E E S G--P V E L	2133
CAECIL	-H P E F T V QEDV-----M E F E M D E L NQ H EC M A A M T G L I K Y M Q K TQIT P K V E E G T V--P Q D L	2135
SNAKE	-I T D T V V PGDM-----M E LE M DE L NQ H EC M T S M T T L L K H M H R N N IT P V V E K D T N--S P E L	2132
CANARY	-P T E Y K V LNDE-----M E LE M DE F NQ H EC M A S M T S L I K H M E R NQIT P K V E E G T V--P A D L	2124
OSTRICH	-P T E Y MALDDD-----T E LE M DE L NQ H EC M A S M T T L I K H M Q R NQIT P K V ED G T V --P V D L	2094
GECKO	-P T ES M GLGDI-----M E LE M DE L NQ H EC M A S M T T L I K H M H R N N IT P T V E K G A V--L P D L	2133
TURTLE	-P T ES M DPDDL-----M E LE M DE L NQ H EC M A S M T T L I K H M Q R NQIT P K V DE G I V --P R D L	2133
ALLIGATOR	-S T ES M VLDD E -----M E LE M DE L NQ H EC M T A M T T L I K H M Q R NQIT P Q V DE G A V --S V A L	2091
PLATYPUS	-Y R DP V TQSDV-----L E LE M DE L NQ H EC M A T M T AL I K H M Q NNQIT P K V E E G S G--S T N L	2126
TASDEVIL	-R I DS M VQDDV-----M E LE M DE L NQ H EC M T T M T AL I K H M Q R N HIT P H V K E G S E--P P S L	2128
HUMAN	-QRDP T V HDDV-----L E LE M DE L N R H E C M A P L T AL V K H M H R S L G P P Q G E E D S V--P R D L	2122
MOUSE	-H Q DS M TQDDI-----M E LE M DE L NQ H EC M A P M I AL I K H M Q R N V I A P K G E E G S I--P K D L	2119
CRASSO2	T D T K V M VEDDY-----V E LE M DE L NQ H E G M A N M I A L L K H M Q R A K I I P L V E S G-V--V P E L	2119
POMACEA	G D N K V R LDGDY-----V E LE M DAL N S H E C M A P L VAL L K H I H K N N I F P A A Q S D A S--S Q D M	2118
TRICHOPLAX	T G D S E K A K T I INK F ADE E LE L DDL N K H E C M E ALL T L L D H M A V N K I N P A I E K D T T--P S E M	2114
NEMATOSTELLA	T G K P D Q L G -ED S Y E I G ED V E M DE L N S H E C L T K I C S L T H M K E S N I S P Q P D K G A L--P K D M	2115
PRIAPULA	E S G S AT L AGDY-----V E M E M D E L NQ H EC M A S M V AL I N H L A T T V C --P I Q A A S S--P A H M	2143
SOFTCORAL	S G T P A S P K E S DS D IS S E E LE M DE L N R H D C M T T L V G L I N H L V K N K I S P Q E Q G K E--A N E M	2131
PISTILLATA	S S S T A E Q T D D W Y E V SE D T L E M DDL N R H E S M A K M I S L L K H L V D K K I S P E Q V K D V P--P T D M	2153
HEMICHOR	L P P S A F V K GDY-----L E M E M D E L N L H E C M S N M T AL L K H M K R N K V T P E V A K G T V--P H E L	2165
BELCHER	Q D S S V N I H G D F-----L E I E M D E L NQ H EC M S S M S A V L Q H M A R N N IT P Q V Q K G A A--P K D M	2156
STRONG	S K P V F S P G G E Y-----L E M E DAL N Q H EC M A A M T G V L K H M T N N K I N P D I T K A T K --A E E M	2159
STARFISH	E T P T V V VQ G E Y -----I E M E S D AL N Q H EC M A S L T A V L K H M Q A N K IT P E I P E G S K--A S E M	2173
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70450.1
ARCHAEON	PNWLKECYELV-LSS--KHKKAKMFILRLFINQPVATI IKPWLHMLPGVLENIYS----	2299
MUDCRAB	PPWMTIIQOKLESGE--THRNVKLFLRLMMNTS--RVFAPYAVHF INPVLTCCLVD----	2142
SCORPION	PKWLDNLCKKLEDYS--VHRNIKLFITKLFINNA--EIFKPYAVFLLQPLINLILN----	2145
SPONGE	PPWMTPLHKRMTDSR--TGRNIKLFIVRLITNRP--KIFQPYAKHWLPVLTQFILSGDST	2195
CAPITELLA	PDWMKNIHDKIKNSD--TQLNIRLFLAKVILNGE--SVFRPYASFWFQPLVALATN----	2173
DANIO	PPWMKFLQGKLDNPS--TPLNIRLFLAKLIINTE--EIFRQPYAKHWLGPLMQLVVS----	2182
MILII	PPWMKFLHGKLGNS--IPLNIRLFLAKLIVNSE--EVFRPYAKEWLGPLLQLVVS----	2183
BAMBOO	PPWMKFLHGKLGNSA--TPLNIRLFAKLIIVNTE--EIFQPYAKEWLGPLLQLVVS----	2181
XENOPUS	PSWMKFLHVKLGNTS--TPLNIRLFLAKLIVNTE--EVFRPYARFWIGPILQLIVS----	2194
STERLET	PPWMKFVHGKFGNAS--THLNIKLFLAKLIINTE--EVFRPYARHWLGPLLQLVVS----	2197
GAR	PPWMKFLOGKLGNS--TQLNIRLFLAKLIVNKE--EVFRPYAKHWLWPLLQLVVS----	2186
LATIMERIA	PPWMKFLSHKLANPA--TPLNIRLFLAKLIVNTE--EVFRPYAKHWLGPFLLQLVVS----	2185
CAECIL	PPWMKFLHGKLGNTS--TPLNIRLFLAKLIANTE--DVFRPYAKQWLGPLLQLVVS----	2187
SNAKE	PPWMKFLHNKLGNT--VPLNIRLFAKLIIVNTE--EVFQPYAKWWLGPLLQLVVS----	2184
CANARY	PLWMKFLHGKLGNS--VPLNIRLFLAKLIVNTE--DVFRPYAKHWLGPLLQLVVS----	2176
OSTRICH	PLWMKFLHGKLGNS--VPLNIRLFLAKLIANTE--DVFRPYAKQWLGPLLQLVVS----	2146
GECKO	PPWMKFLHSKLGNS--VPLNIRLFAKLIIVNTE--EVFQPYAKQFLGPLLQLIVS----	2185
TURTLE	PPWMKFHKGKLGNS--MPLNIRLFLAKLIVNTE--EVFRPYARQWLGPLLQLVVS----	2185
ALLIGATOR	PPWMKFLHSKLGNS--VPLNIRLFLAKLIVNTE--EVFRPYARHWLGPLLQLVVS----	2143
PLATYPUS	PPWMKFLHGKLANPL--GALNIRLFLAKLIANTE--EVFRPYARHWLGPLLQLVVS----	2178
TASDEVIL	PPWMKFLHNKLENPS--TPLNIRLFLAKLIINTE--EVFRPYAKHWLNPLLQLVVS----	2180
HUMAN	PSWMKFLHGKLGNPI--VPLNIRLFLAKLIVNTE--EVFRPYAKHWLSPLLQLAAS----	2174
MOUSE	PPWMKFLHDKLGNS--VSLNICLFLAKLIVNTE--EVFRPYAKHWLSPLLQLAVC----	2171
CRASSO2	PAWMKNLNDKLRSPR--THNNIKYFITKLIINTA--EIFRQPYARDWIRPLTQLIIS----	2171
POMACEA	PQWMVFLHDKMTKNTGSDTLNIRLFLAKLIINTS--EIFQPFARLWLRPLCQLILS----	2172
TRICHOPLAX	PSWMVALRKKASDHT--TNRNIKLFIAKLIINRP--KIFRQPYAKFWLVPLLIQLIV----	2165
NEMATOSTELLA	PSWMSALHKKLTNFE--THLNIQFLIAKVIINQS--QVFEPYARFWLSPLMELILKLEE	2171
PRIAPULA	PAWMELLHGKFSHVE--TPLNVRFIARLVVLC--HAFRQPCAAASWLAFLMHLVVN----	2195
SOFTCORAL	PPWMSYLHKKLSHHS--SELNVRLFAKLIITNLP--EVFEPYAKFWLDSLMEILILL----	2183
PISTILLATA	PAWMAPLHKKIASSS--THLNIRLFLAKLIINEA--KIFEAHAKFWFNPLMELILQIKDT	2209
HEMICHOR	PGYMSYLQKKSGPS--TNPNVKLFIIKLIINAE--EVFRQPYAKFWLAPLMEWILG----	2217
BELCHER	PPWMSCLNKKLGGSS--THKNVKLFLAKLIVNNE--EVFRPYARFWLSPLMEMIVR----	2208
STRONG	PQWMSGKQKLSQS--TEHNKLFIVRLVINAQ--DVFPYARFWLSPLMQFLAG----	2211
STARFISH	PGWMASLQKLSQS--THVNIKLFIARLIINNN--EVFTPYARFWLSGLLQLLIS----	2225
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70450.1
ARCHAEON	IYC-----HNKKGYHYLLRDMFTFWDTWADV TIPVASLK---HAGMILNFLLLTHLDHDD	2351
MUDCRAB	GTT-----GDRINIFYFSDLIVMVM-GWGKRAGSQDSTMGRNMVSRVLRFLCSNTPHNR	2194
SCORPION	ATF-----GREINIFYILDMVLL-SWSSIAIPEDSSIGRHAASGLLEFLMSKCFHIR	2197
SPONGE	AGMGGAVGGGENGLDYFTVDAIATML-SWSSTAIIED----RFLGSQLEYYIMLRSNHKN	2250
CAPITELLA	-----MGGLNYFSLDIIVTLL-SWHEIAIPEETTVDIAMTSHLVKYIVQNCYHQN	2222
DANIO	SSN-----G-GEGIHYFMVVDIVVTVL-SWASVSPKGNTRDEVLVNRLGFLFKNCFHSK	2235
MILII	GNN-----G-GDGIHYMVVEIVVTVL-SWTSVATPKGNMKDEILANRLEFLMKNSFHEK	2236
BAMBOO	GNN-----G-GDGIHYMVVEIVVTVL-SWISVATPKGDLKNEILANRLEFLMKNCFHEK	2234
XENOPUS	GNN-----G-GTGIHYMVVEITLVTL-SWSSIATPNGQAKEEILANRLEFLMKNVFHEK	2247
STERLET	GNN-----G-GEGIHYMVVEIVVTVL-SWTSLASPKGNTRDEILANRLEFLMKNAFYDK	2250
GAR	GNN-----G-GEGIHYFMVVEIVVTVL-SWASVATPKGDTKDEVLANRLEFLMRNAFHEK	2239
LATIMERIA	GNN-----G-GEGIHYMVVDIVVTVL-SWANIAPKGNTRDEILANRLEFLMKNTYHEK	2238
CAECIL	GNN-----G-GDGIHYMVVEIVVTVL-SWANVATPAGLAKDEILANRLEFLVTHSFHEK	2240
SNAKE	GDN-----G-GEGIHYMVVEIVVTLL-SWTNVATPKGNIKDEVLANRLEFLMKNVFHQK	2237
CANARY	GNN-----G-GEGIHYMVVEIVVTIL-SWTSVATPKGNIKDEILANRLEFLMKNAFHPK	2229
ONSTRICH	GNN-----G-GEGIHYMVVEIVVTLL-SWTSVATPKGNIKDEILANRLEFLMKNAFHPK	2199
GECKO	GDN-----G-GEGIHYMVVEIVVTLL-SWTSIATPKENIKDEILANRLEFLMKNAFHPK	2238
TURTLE	RDN-----G-GEGIHYMVVEIVVTLL-SWTSVAAPKGNIKDEILANRLEFLMKNVFHQK	2238
ALLIGATOR	RDN-----G-GEGIHYMVVEIVVTLL-SWTSVSPKGNVKDEILANRLEFLMKNTFHQK	2196
PLATYPUS	GEN-----G-GEGIHYMVVEIVATVL-SWTSIATPTGVTKDELLANRLEFLMKHVFHPK	2231
TASDEVIL	ENN-----G-GEGIHYMVVEIVVVVL-SWTSIATPKGVPKDELLANRLLQFLMKHVFHPK	2233
HUMAN	ENN-----G-GEGIHYMVVEIVATIL-SWTGLATPTGVPKDEVLANRLLNFLMKHVFHPK	2227
MOUSE	EN-----N-REGIHYMMVEIVATIL-SWTGLATPTGVPKDEVLANRLLRFLMKHVFHPK	2223
CRASSO2	GLF-----TGLNYFVIDIVVTIM-SWHQVAIPQDTEVEDRAMSSRLVEFVMGYVYNDT	2222
POMACEA	TSL-----C-DNGINIFYIMDLLVTML-SWHSTAVPQNSSTERAMASRLVEFLVRNVHET	2225
TRICHOPLAX	EGK-----E-SDGIHYFIVDLMIILL-SWADVAI PKDVD-EILQANRLMEFLMRNAFYPN	2217
NEMATOSTELLA	EGE-----N-KRGLNYFVVDLLVTIL-SWATTAIPEDSYGDRHLASRLLQTVMRRTHHEN	2224
PRIAPULA	GNC-----GVAAAIHSLTADV VVVML-SWTPVARPQDNMTERSLASRLEFLMRNARHAT	2249
SOFTCORAL	PTF-----K-NSELNYFVIDIVVTML-SWSSVTIPEDSYSSRRLTSRLLLEYLMETCNHPT	2236
PISTILLATA	EPA-----G-TEGINIFYIVDLVVTLL-SWSTTAIPEDSHNDRHLASRLLGFLMSRTRHRH	2262
HEMICHOR	GQT-----G-GDGIHYMIGDIVVLML-TWSAI AKPEAGD--RILASRLVEYLMHHTHHSN	2268
BELCHER	GEA-----S-GEGINIFYIVDLLVTML-SWGPVAIPEDSAMGRALTSRLLHFLMANAFHKT	2261
STRONG	GQQ-----G---GINYMVLDIMLVML-DWSTLAVPEDNR----LASGVLRFLMKNSYHER	2258
STARFISH	GNT-----G-GEGIHYMVVDVVVLL-GWVTVAIPEDKR----LANRLEFLMHFCHHSN	2274

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus “putative archaeon”

		RYG70450.1
ARCHAEON	PDV LKENL NSVCSIFPR WLQ LYSTSQQKTR IY NIAL PYVPLE VD AI IRLLNTAYTMTGGA	2411
MUDCRAB	AD VFRY NIDAVK SV VE CWRAVLTV----- PYAI I-----YSL-----	2226
SCORPION	KD VFRN NLEMI K TVV QCW KER LDI----- PTYI I-----FES-----	2229
SPONGE	RS ILRN NLEI VR TM VEL WKD KIDI----- PTRV L-----YDQ-----	2282
CAPITELLA	RQ IMRN NLEVL K TLV EAW KST IRI----- PTQD I-----YEN-----	2254
DANIO	RA VFRH NLEI I IRT V VE CW KDCL TI----- PYDL I-----YER-----	2267
MILII	T AVFRH NLEI I IKT V VE CW KDCL SV----- PYSL I-----FSR-----	2268
BAMBOO	RV VFRH NLEI I IKT V VE CW KDCL SI----- PYSL I-----FDR-----	2266
XENOPUS	RA VFRH NLEI I IKT V LE CW KECL SI----- PYRL I-----YEG-----	2279
STERLET	RA VFRH NLEI I IKT V IE CW KDCL AV----- PYSL I-----FDR-----	2282
GAR	RA VFRH NLEI I IKT V VE CW KDSL MV----- PYSL I-----FDR-----	2271
LATIMERIA	RA VFRH NLEI I IKT V VE CW KDCL AV----- PYSL L-----YQR-----	2270
CAECIL	RA VFRH NLEI I IKT V VE CW KDCL SI----- PYRL I-----FER-----	2272
SNAKE	RA VFRH NLEI I IKT V IE CW KDCL SI----- PYRI I-----FQL-----	2269
CANARY	RA VFRH NLEI I IKT V IE CW KDCL SI----- PYSL I-----FQR-----	2261
OSTRICH	RA VFRH NLEI I IKT V IE CW KNCL SI----- PYSL I-----FEK-----	2231
GECKO	RA VFRH NLEI I IKT V VE CW KDCL SI----- PYRI I-----FER-----	2270
TURTLE	RA VFRH NLEI I IKT V VE CW KDCL SI----- PYRL I-----FEQ-----	2270
ALLIGATOR	RA VFRH NLEI I IKT V VE CW KDCL TV----- PYRL I-----FEQ-----	2228
PLATYPUS	RA VFRH NLEI I IKT V VE CW KDCL SI----- PYRL I-----FEK-----	2263
TASDEVIL	RA VFRH NLEI I IKT V VE CW KDCL SI----- PYRI I-----FEK-----	2265
HUMAN	RAVFRHNLEI I IKTL VE CW KDCL SI----- PYRL I-----FEK-----	2259
MOUSE	RA VFRH NLEI I IKT L VE CW KECL SI----- PYRL I-----FEK-----	2255
CRASSO2	RP VYRN NLELL K TL L QV W KDR VEI----- PYNIV -----YKH-----	2254
POMACEA	RA IFRN NLEML K TL L EC W KDCI EI----- PYQEV -----YNO-----	2257
TRICHOPLAX	RS VLRN NIEI I IKT A VEL W KNH IEI----- PYRI I-----YKN-----	2249
NEMATOSTELLA	RA VFKN NLEI IV KTM VE VWR ERVTV----- PTKVI -----YEA-----	2256
PRIAPULA	MS VFRN NLEI I IKT L VE CW RDR VDV----- PSQVI -----YEN-----	2281
SOFTCORAL	RS IFKN NLEVI IK TF VE VW KERIDV----- PYKLI -----YER-----	2268
PISTILLATA	RS LFRN NLEI IV KSV VE IW KSILHV----- PAEVI -----FNS-----	2294
HEMICHOR	RQ VLRN NLEMV K TV VEL WRDC IEV----- PSRVI -----FEA-----	2300
BELCHER	RA VMRN NLELI IK TAVE CW KTR VEV----- PTKVI -----HDQ-----	2293
STRONG	KS VMKN NLEVI IK TL VE CW KDVIDV----- PTRVI -----YES-----	2290
STARFISH	RQ VLRN NLEMI K TL VE CW KEIISV----- PTSVI -----YRI-----	2306
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70450.1
ARCHAEON	HGSIYSTGSI AVR YRLAALDVVHCLLD CNY PLLVDYTLVNNVLSNFGNPN--TNITTQAL	2469
MUDCRAB	----MEVSDGRNKEQEAGLNLGIMLANG-----LAPY-TED--SVAEKTKC	2266
SCORPION	----MRNLDTKVKDNIVG IQLF GIVV SNG-----LDPY-QNT--SRIDKISY	2269
SPONGE	----FSNSDKSTVSNLSGIQLVGI AVANE-----LNPY-DTNTAGSLDQGLY	2324
CAPITELLA	----FIDREDK GKRN VVGLQIVGVFLANG-----LSPW-QPD--AEVSKDRF	2294
DANIO	----FAGTDPNSKDNSVGIQLLGIVMANN-----LPPY-DAA--CGIEH DRY	2307
MILII	----FSSTDPNSKDNSVGIQLLGIVLANN-----LSPY-VPK--CEIGYERY	2308
BAMBOO	----FAGRDPNTKDNSVGIQLLGIVLANN-----LPPY-DCK--CEIDSERF	2306
XENOPUS	----FSGTDPNTKDNSVGIQLLGLALANN-----FSPL-DPK--CGIDPERY	2319
STERLET	----FSGKDPNSKNSVGIQLLGIVLANN-----LPPY-DPK--CGIDSESY	2322
GAR	----FAGSDPNSKDNSVGIQLLGIVLANN-----LPPY-DPS--CGIEHERY	2311
LATIMERIA	----FSGKDPNTKDNTVGIQLLGIILANN-----LPPH-DPT--CSIDMESY	2310
CAECIL	----FSNGNTNSKDNSVGIQLLGLILANN-----LPPY-DPK--CGIDVERY	2312
SNAKE	----FS-GDPNTKDNSVGIQLLGIVLANN-----LPPY-DPK--CEIDSIRY	2308
CANARY	----FSSGDPDTKDNSVGIQLLGIVLANN-----LPPF-DPK--CEIDRVRY	2301
OSTRICH	----FSGGDPNTKDNSVGIQLLGIVLAND-----LPPF-DPK--CEIDRVRY	2271
GECKO	----FSGGDPNTKDNSVGIQLLGIVLANN-----LPPY-DPK--CEIDNVRY	2310
TURTLE	----FSGGDPNTKDNSVGIQLLGIVLANN-----LSPY-DPK--CEIDSVRY	2310
ALLIGATOR	----FSGGDPDTKDNSVGIQLLGIVLANN-----LPPY-DPK--CEIDSTRY	2268
PLATYPUS	----FATGDPNTKDNSVGIQLLGIVLANN-----LPPY-DPK--CGIDSARY	2303
TASDEVIL	----FSNRDPNSKDNSVGIQLLGIIMANN-----LPPY-DSK--SGIESTRY	2305
HUMAN	----FSGKDPNSKDNSVGIQLLGIVMAND-----LPPY-DPQ--CGIQSSEY	2299
MOUSE	----FSHKDPNSKDNSVGIQLLGIVLANN-----LPPY-DPN--CDITSAMY	2295
CRASSO2	----LKQPDETKKESCVGIQLMGVLSAK-----FPPY-APT--APVDQEKF	2294
POMACEA	----LKMPDPSSKSSLI GIQVLGVIMTCN-----YAPY-GPS--ASVDRNRY	2297
TRICHOPLAX	----FSNPDKDKKDNSTGIQCLGLV VANG-----LSPY-RYD--VEVDEM--	2287
NEMATOSTELLA	----LSNPHPKKDNATGIQLLGIVLANK-----IHPF-SSD--SSVDENTF	2296
PRIAPULA	----MCAGDITMRDNSVGVQLLGIVVANN-----LPPY-SHT--TAVDSEKF	2321
SOFTCORAL	----FSNASVNTKENS VGIQLMGVIVANK-----ITPF-KPG--CGVDEKRF	2308
PISTILLATA	----FSDPDPVKKDN AVGIQLLGIVVANG-----LFPV-TSD--STIDEDRF	2334
HEMICHOR	----FSGKDPKGENATGIQLLGIVLSNQ-----LPPY-RDT--CGIDKDRF	2340
BELCHER	----LCGS DASSKANSVGIQLLGIVLANQ-----LPPF-NPSTSGNIDREQF	2335
STRONG	----LQDRSPDKKDSAVGIHLLGVILANN-----LHPL-SPT--CDVDADRF	2330
STARFISH	----LATPDPDVKDSSTGLQLLGIVLANG-----LHPI-DKA--SDIDEERF	2346

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus “putative archaeon”

		RYG70450.1
ARCHAEON	LQAILDNLIS-ISRKELVQSSCQVIGQILDLLNAHSMQAKQVLLYSQLGEFENKVVDIIDG	2528
MUDCRAB	EKILLKLE-AHYASIIYGAAAEEVGLVLKQSSHSEDCN-----ETSFEENVARKVME	2318
SCORPION	LKTLTVNLK-NKYKEIYESASEVCGMSMKYFDDKDDV-----YSEFCKIVKTEISS	2320
SPONGE	YKIFVNNLT-FKYKLIYAAAEEVGMIMKRMAESYDPF-----LDRLEEMVGEQLFK	2375
CAPITELLA	YQYLAMNMN-QPDKQVYSASAEIVGMALSSLQNTESDKE-----WCRA YGDNIQKMLLG	2347
DANIO	FQSLANNLSFIRYKEVYAAAEEVIGLILNYMTERENQI-----EGTLFNITVTKLMD	2359
MILII	FQRLVYNI SLTRYKEYVYAAAEEVGLV LHYFAENEKQV-----DGLVHDLIAKELKQ	2360
BAMBOO	FQRLVHNI SLTRYKEYVYAAAEEVGLV LQYLAG--KPM-----DCAVHDLVVKELQQ	2356
XENOPUS	FQSLANNLGLTRFKEYVYIAAAEEVIGLV LRYIVQNEKRT-----EAPVFDYVVKELKR	2371
STERLET	FQALATNIFSGRFKDIYAAAEEVIGLIMQYLAKNEKQL-----EGPIFDFTVKELKH	2374
GAR	FKSLANNISFVRYKDIHVAAAEEVIGLVMQYMAEKEKQS-----EGPIFDFTAHHLKK	2363
LATIMERIA	VKALANNLSFTRYKEYVYAAAEEVGLV LQYRAEKEKEL-----GGPIIDSVVRELKQ	2362
CAECIL	FQALANNIALTKYKDIYLAEEVGLALHYVAEKEKTL-----EGPLFDCVIKELKQ	2364
SNAKE	FQALSNNIALIRYKEYVYVAAAEEVGLILQYIAEKENTF-----EGPIYDMVIKQLKL	2360
CANARY	FQALTSNMGLLKYREVYAAAEEVGLALQYIAERENIL-----EDPVYDCVIKQLKH	2353
OSTRICH	FQALISNMGLLKYREVYAAAEEVGLALRYVAERENIL-----EDPAYDCVIKQLKH	2323
GECKO	FQALANNMALVRYKEYVYAAAEEVGLV LQYIAEKENIY-----ESPVFDIIKQLKQ	2362
TURTLE	FQDLANNMSLIRYKEYVYAAAEEVGLILQYMAEKENIF-----EGPVYDCVIKRIEQ	2362
ALLIGATOR	FQALVNNMALLKYKEYVYAAAEEVGLTLRYIAEKENIT-----EGPIYDCVVKQLKQ	2320
PLATYPUS	FQALANNLSLVKYKEYVYAAAEEVGLTLQYVSEKETML-----EDSICELIVKQLKQ	2355
TASDEVIL	FQALVNNMSFIKYKEYVYAAAEEVGLILQYIAKKENVL-----EDSVFELVVKQLKQ	2357
HUMAN	FQALVNNMSFVRYKEYVYAAAEEVGLILRYVMERKNIL-----EESLCELVAKQLKQ	2351
MOUSE	FEALVNNMSFVKYKEYVYAAAEEVGLILQYITERKHVI-----AELVCELVIKQLKQ	2347
CRASSO2	FTTVAQYMR-NRYKAVYAAATAEIVGMIFKHLAEKDRQT-----EGTFHDYVVNLMNS	2345
POMACEA	FTTLASSMT-NSSKMIFAAAAEEVGMVFAYLADKENET-----DGQFHSHVESVL--	2346
TRICHOPLAX	-LALAENLQ-FKYKEYVEAAAEVGMIMKHLASVKKET-----EGPIFDYVTQHLS	2337
NEMATOSTELLA	YTALSDNLT-FKYKDVHAPAAEVS GMLMKYLI EERKVT-----ECSLIALVEAKLSP	2347
PRIAPULA	FQAIVRCLA-NKYKEYVYAAAEEVGMILHRMVEREDEEA-----EGALRDAVVTAMST	2373
SOFTCORAL	YQDLVKNLS-FKYKDVHGAEEVIGMILKYLSEENDKES-----CDGLSGLLNEKLS	2360
PISTILLATA	YGTLVNNLT-FKYKDVHAAAEEVIGLLMMQLAKVKKIF-----DGPLHDMVGQKLLS	2385
HEMICHOR	YTTLSANLS-FKYKDVYAAAEVGV-MKYMAEKEKVT-----DGT FHDNVFREISS	2390
BELCHER	FSAVAKNLQLTRYKDVYAAAEEVIGMIMKYMADVEKVT-----EGSFHTQVERYLLP	2387
STRONG	YSALASNID-NRYKAVHGAEEVIGMAMKQMAENDKIT-----DGRLHEVTYKELSQ	2381
STARFISH	YAALSYNLK-NRYKMHAAAEEVIGMAMKQKADVVKVT-----DGFLHSIVTSELTK	2397

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus “putative archaeon”

		RYG70450.1
ARCHAEON	K-DKAKRGKETVVYCYKCILANYSGLKREMICRPLLWFNSFTFQGRYSY--LEMLLRHN	2585
MUDCRAB	M---MHSKQGQGITVIYKIHLHFPAVLK-----RVMNRLLSVLPNLY	2357
SCORPION	L-----NAKDQYLTCLYKINTHFPIFID-----SSFLNKILYMLPNVH	2358
SPONGE	LSQPLEKSEDKFITCLHKITLCYNKIVP-----RFVEKLLFLLPSLQ	2417
CAPITELLA	I---HGKPDQFLTCTVHCIQKHFSAFVE-----RFIHKVLFMLPGLY	2386
DANIO	LR--KKEVDDKFIVCLSKVSKHFPPDVD-----RFINPVFYLLPKLH	2399
MILII	LQ---QSKEDKFIVCLSKIIVKNYPPFAD-----RRFLNQVFYLLPKLH	2400
BAMBOO	LQ---NTKEDKFIVCLSKIIVKHFPFAD-----RFMNAVFFLMPKLY	2395
XENOPUS	HQ--TNNKEDKFIMCLNKVVKNFPFAD-----RFMTIVLFLPKLH	2411
STERLET	LQ---NTKEDKFVECLSKVVKNFPPLVD-----RFLNAVLFLLPKLH	2413
GAR	LQ---NEKEDKFVVCLSKVVKNFPFMD-----RFVNAVFFLMPKM	2402
LATIMERIA	LQ---SIKEDKFIVCLSKIIVKNFALLAD-----RFMSVVFLLPKLH	2401
CAECIL	HQ---NAKEDKFIMCLNKVVKNFSPAD-----RFMTVVLFLPKLH	2403
SNAKE	HQ---NTRDDKFIVCLNQITKNFPPLAD-----RFMSFVFFLIPKLH	2399
CANARY	HQ---NTQHDKFIQCLNKVVKNFPPLAD-----RFMNAVFFLIPKLH	2392
ONSTRICH	HQ---NTQQDKFIQCLSKVVKSFPPLAD-----RFMSAVFFLIPKLH	2362
GECKO	HQ---NTREDKFIICLNKLAKNFPPLAD-----RFMNTVFFLIPKLH	2401
TURTLE	HQ---STKEDKFIVCLNKVAKNFPPLAD-----RFMNAVFFLIPKLH	2401
ALLIGATOR	HQ---NTKEDKFILCLNKVVKTFPPVAD-----RFINAVFFLIPKLH	2359
PLATYPUS	HQ---NSREDKFIVCLNKAVKNFPPLAD-----RFLNAVFFLIPKLH	2394
TASDEVIL	HQ---NTKEDKFIVCLNKAVKTFPPAD-----RFMNAVFFLIPK	2396
HUMAN	HQ---NTMEDKFIVCLNKVTKSFPPLAD-----RFMNAVFFLIPK	2390
MOUSE	HQ---NTMEDKFIVCLNKIAKGFPPAD-----RFLNALFFLIPK	2386
CRASSO2	L---QQSNPGNFFLLCIHRMHLHYPPAD-----RFMNRLLFVLPNLH	2384
POMACEA	---GKVAPHNFLVCVHCIHRHYPPMAD-----RFLNKLLFMLPGLH	2384
TRICHOPLAX	MVSAGRMDVARFILCLYRVQLHYPIAD-----RFVNKVLFLMPSLY	2379
NEMATOSTELLA	MATKGGKDIGKFITCVHRLQLNYPRIVD-----RFMKHIMFHLPTIH	2389
PRIAPULA	L---HADAKQNFIVCLQKMTLHYPAIADREVMTAVSDRYLGQVCGDRLMSKLLFMLPSLQ	2430
SOFTCORAL	---MTKDLDKFILCVHQLQIHFPPIVD-----GFINQILFVQHVH	2398
PISTILLATA	LVNRAKPELDFITCVHKLKLNYPPIVD-----RFVNQILFTLPSVH	2427
HEMICHOR	S---QSSRPEVFITCIYKVQLYYKPFDT-----RFINKLLFMLPQIH	2429
BELCHER	L---QVNQQDVFITCVHKIHLHFPPFAD-----RFVSKLLFMLPKLH	2426
STRONG	LH-LGSGKEVIFITCLHKIHLHYPVFTD-----RFMNKLLFMLPSIH	2422
STARFISH	I---SEIKPDVFTTCIHKLHFHYPEFAD-----HFTNKLFLMLPSLH	2436

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70450.1
ARCHAEON	SIFVKS G TDCS HVM ILELVRSFIK P MLVDRNVTAIGRGAGMVKI P LLQVYAL I LLTKHIQ	2645
MUDCRAB	GIF---CTR VLECL -----ASYSSS-----ME--DI Y SHLKEHNVLG	2389
SCORPION	GIF---RKQ ILEII -----NSHVEN-----IE--NA FAEL KNQGLLN	2390
SPONGE	GVF---RSS CLEIL -----DTQADV-----QP--Q F Y LKL KDKGFHT	2449
CAPITELLA	GVF---RTYA LEII -----AAGIEN-----IE--GA FVEI KNKNIIG	2418
DANIO	GML---KTH CLECV -----LSRADV-----IP--EI FLHL KTKGLSQ	2431
MILII	GVL---KTH CLEVV -----MHRAET-----II--DI FQEL KNKNFVQ	2432
BAMBOO	GIL---KTH CLEVV -----MYRAEE-----IP--DI HIQL KSKDFTQ	2427
XENOPUS	GVL---KTQ CLEII -----MHRAED-----IP--DL FIEL KNKDFCQ	2443
STERLET	GVL---KTH CMEIL -----MSRAEE-----VT--DI YLQL KSKDFAQ	2445
GAR	GVL---KTH CLECI -----LSRAEE-----IP--DV YLQL KSKDFSQ	2434
LATIMERIA	GVL---KTH CLEVV -----MSRAEE-----IP--DI FLQL KSKDFIQ	2433
CAECIL	GVL---KTY CLEVV -----MCRAEE-----IP--DL YIQL KSKDFNQ	2435
SNAKE	GVM---KTH CLEVV -----MCRAQE-----IP--DM YLEL KSKKEFIQ	2431
CANARY	GVM---KTY CLEVI -----MCRAEE-----VP--DL HLQL KSKDFIQ	2424
OSTRICH	GVM---KTH CLEVI -----MCRAEE-----IT--DL HLQL KSKDFLQ	2394
GECKO	GVM---KTY CLEVV -----MGRAHG-----IP--SL YLEL KSKDFTQ	2433
TURTLE	GVL---KTY CLEVV -----MYRAEE-----IT--DL YLQL KSKDFIQ	2433
ALLIGATOR	GVL---KT S C LEVV -----MCRAEE-----IT--DL YLQL KSKDFMQ	2391
PLATYPUS	GVM---KT F C LEVV -----LCRAEE-----IT--DL YLQL KSKDFAQ	2426
TASDEVIL	GVM---KT L C LEVV -----LCRAEE-----IH--DL YLQL KSKDFIQ	2428
HUMAN	GVL---KTLCLEVV-----LCRVEG-----MT--ELYFQLKSKDFVQ	2422
MOUSE	GVM---KT L C LEVV -----LCRAEE-----IT--GL YLQL KSKDFLQ	2418
CRASSO2	AEF---RNR CLEIV -----LTRIDT-----LE--NV YVEL KSKGLLA	2416
POMACEA	GEF---RVQ CLEVI -----MGCIEQ-----LD--DA FREL QSKGLLN	2416
TRICHOPLAX	GEF---KTK LEII -----LARADH-----IK--E L Y TEL RNKGLKD	2411
NEMATOSTELLA	GVF---KAQ CLEIV -----LSRVSD-----IP--DL FTEL RSKGLNV	2421
PRIAPULA	GSF---RSQ CLEVI -----LTRVAH-----TQ--NL FLEL KSKGFLG	2462
SOFTCORAL	AQF---KT L C LEII -----LSRVGV-----IP--NL FLEL KTKGFLN	2430
PISTILLATA	GDF---KSY CLEIL -----CSRVEH-----IP--NL FTEL KGRGLKE	2459
HEMICHOR	GQP---KTYA LEV V-----LGRVDS-----ID--KI FLEM KNKRILE	2461
BELCHER	GIF---RTH CLEVI -----RGRVNV-----ID--NL FLEL KTRNFLG	2458
STRONG	GQP---KTE CQII -----TARIEH-----ID--NA FIEM KNKNILA	2454
STARFISH	GQP---KT L C LEVV -----ASRVSH-----IP--NI FLEM KSKGIVE	2468
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

			RYG70450.1
ARCHAEON	HICNTSEGRQDPETKQHNETVQLQEVLSIIIGKDETVAVRYCINA-----NNHVSVRYA		2698
MUDCRAB	LLSKKEESTQLV-----SLELVNAVLPRLTPSQVLYFLPG-ITGFASHPGAKCREM		2439
SCORPION	MLEHRDESIQFS-----SLNIIQKLLKELDIDKMLNVFPI-ISKVHKSAETICRKV		2440
SPONGE	MI SHRDEATQTA-----SLSIVQKLLVQLTNDQLSEIVPILIASFSKHGSIQCRIV		2500
CAPITELLA	ILRERDELSQLM-----SLKII RRLLLEKLEASQLLYLLPA-ICEISDLSSVLCRRE		2468
DANIO	IMSHKDEGRQRV-----CLDI IHKILACLKPEELKEILGA-VTAFASHPSPVCRER		2481
MILII	IMSYSDERQRI-----CLDIVYKIIAKLKAEVKVFLVP-VIAFISHPSPVCRER		2482
BAMBOO	IMSHRDEDRQRV-----CLDIYRIKAKLKSAE LKELLRS-VVAFISHPSPICRER		2477
XENOPUS	IMNRRDDRQRV-----CLDIYKILSKLTPAELHEFLIP-VTAFSSHSFPVCRER		2493
STERLET	IMSHRDEMRQRV-----CLDIVHKILAKLKPVELKELLIS-VTAFTTHPSPVCRER		2495
GAR	VM SHRDEARQRV-----CLDI IHKIMAKLKPVEMREMLGA-VTSFVTHPSPVCRER		2484
LATIMERIA	LMNHRDDARQRV-----CLDIVYKIMFKLKPVEMKEFLVA-VTGFISHPSTVCRER		2483
CAECIL	IMSHRDDDRQKV-----CLDIYKMLPKLKPME L GELLNT-VVTFSSHSPSPMCRER		2485
SNAKE	VMCHRDDRQRI-----CLNIVYKMLPKLKP AEVLELLPS-VTGFISHPSPLCRGQ		2481
CANARY	IMNHRDDRQRV-----CLDIVHKMLSKLKPLE LKELLPG-VTGFISHPSVMCQRQ		2474
ONSTRICH	IMNHRDDRQRV-----CLDIVYKMLPKLKP LE LKELLPG-VTGFISHPTVICRQR		2444
GECKO	IMSHRDDRQTV-----CLDIVYKMLAKLTPAEVQELLPT-VTGFITHPSPLCRGR		2483
TURTLE	VMSHRDDRQRV-----CLDIVYKMLPKLKP LE LRELLPG-VTGFISHPSPVCRER		2483
ALLIGATOR	VMNRRDDRQRV-----CLDIYKMLSKLKP LE LRELLPG-VTGFISHPSPVCRER		2441
PLATYPUS	VMRHRDDRQRV-----CLDIYKMLAKLKPGE LRELLNV-VVEFISHPSPVCREQ		2476
TASDEVIL	IMRHRDDRQKV-----CLDIYTMLAKLKPVE LQELLNC-VVEFISHPSPVCREK		2478
HUMAN	VMRHRDDRQKV-----CLDIYKMMPKLKPVE LRELLNP-VVEFVSHPSSTTCREQ		2472
MOUSE	VMRHRDDRQKV-----CLDIVYKMVAKLKPIELRELLNP-VVEFVSHPSPTCREQ		2468
CRASSO2	FLTHRDETQVI-----ALKIVKSIQSKLQPS EVSELLPL-ICGFCVSPSIPCRNV		2466
POMACEA	FLTQRDEDTQIV-----ALGIVNAMVPKLSATE LQTFLLPA-ITGFSNHPSVTQRQI		2466
TRICHOPLAX	MLLHRDESKQOV-----SLDLVRAMLKNLDISQ ILYLAEL-VATFKTNPSAACRQK		2461
NEMATOSTELLA	MFEHRDEGVQVA-----LLKIIQGLLEK LKMSEIEYVVPS-IATMATSSSTACREL		2471
PRIAPULA	MITHRDEATQLA-----SLHITNALLSSLSPG ELLFLLPA-VTSIGTHPRAPCRQL		2512
SOFTCORAL	TLTHRDEATQVA-----CLR IILGRLSQMSVGD IQTLLPS-VTDFLSSKSVACRGL		2480
PISTILLATA	MLSQRDDGIQIG-----VLR IIKHLMK KLTIPELKFIFPL-LTSFVSHPNLLCRDL		2509
HEMICHOR	MLRHRDETIQLV-----SLKIVNSMLKRLNEE ELLYLMPT-VVSFSKNLSPACRET		2511
BELCHER	MLTHRDDGLQAI-----VLQIVYALLQKLKVE ELLYLLPS-VAAFASHPAPECRRT		2508
STRONG	LLTHKDEADQLT-----SLKLV DGMLPKLKPSELRYLLPA-VKDFVSHPSPSCRDT		2504
STARFISH	LLTHRDEGTQLV-----SLKLVNAML PNLKPDEILYLLPP-VRTVFNLPSPACREV		2518
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70450.1
ARCHAEON	AYNLLISIFI-YREKLL--AG--SSSKDVLQSIQVQLLLNGLNDPDGDIYSKTDVAGQLPK	2753
MUDCRAB	MYDILFWIYDNFRESSD-----SEGSQIEAKTRVSLAQVKEKDAAL-----	2481
SCORPION	MYEIMMHAYEKFNNTKNG-----IKEKEISRYAKEMLLHGLADSDLTL-----	2482
SPONGE	LYNILMRVYNKLCDDQSESD--DSVKMIRSISRQQLLGLGDESNEV-----	2546
CAPITELLA	MYQILMWCYDNYKDEAQS-----ESRDEIITLTKDVLLRGLSDDDLTN-----	2511
DANIO	MYDILMWIQDNYSDES-RED--STSVEVLSVARETLLQGLTDENYGL-----	2526
MILII	MYDILMWIYDNYRDAES-QSD--PDSKAVFVTTKDTLLQGLTDENPAL-----	2527
BAMBOO	MYDILMWIYDNYRDPES-QSD--PDSKEIYTETSDALLQGLTDENPAL-----	2522
XENOPUS	MYDIFMWIYDNYRDHES-QND--SKSVEVFNMMAKEGLLQGLVDENDEL-----	2538
STERLET	MYDILMWIHDNYRDPES-QSD--SVSTEVFNLAKETLLQGLTDENQGL-----	2540
GAR	MYDILMWIHDNYRDPES-QSD--SDSLEMLNVAKETLLQGLVDENQGL-----	2529
LATIMERIA	MYEILMWIHDNYRDQES-QAN--NESREVLKLASEVLLQGLTDENPGL-----	2528
CAECIL	MYDILMWIYDNYRDPES-QAN--DDSQEVFSRANDVLLQGLIDENAGL-----	2530
SNAKE	MYDVLMWIYDNYSDSES-QAD--EESQLLKVAKESLLQGLIDENSGL-----	2526
CANARY	MYDILMWIYDNYSDPES-QAD--DDSREILKVAKESLLQGLIDENAEL-----	2519
OSTRICH	MYDILMWIYDNYSDPES-QAD--GDSQEVFLAKEILLQGLTDENAEL-----	2489
GECKO	MYDILMWIYDNYRDPES-QAD--EKSSEVFKLAKEVLLQGLIDENSGL-----	2528
TURTLE	MYDILMWIYDNYRDPES-QAE--EESQEVFKLAKEMLLQGLMDENSGL-----	2528
ALLIGATOR	MYDIMMWIYDNYRNSES-QAD--EDSQEVFKVAKEMLIQGLTDEISEL-----	2486
PLATYPUS	MYNILMWIHDNYRDPES-QAD--EESREVFKLAKEILLQGLVDENHGL-----	2521
TASDEVIL	MYNILMWIHDNYRDLES-QTD--EVSQEVFLAKEVLLQGLMDDNLGL-----	2523
HUMAN	MYNILMWIHDNYRDPES-ETD--NDSQEIFKLAKDVLIQGLIDENPGL-----	2517
MOUSE	MYNILMWIHDNYRDQES-QND--EDSQEVFKLAKDVLIQGLIDENVGL-----	2513
CRASSO2	MYDILMWVYDNYREDES-----ETADTIMQQTKESSLKGLGDEDMQC-----	2508
POMACEA	MMKILMWTYDNYRDNES-----KEGQEIIMKVTOESLLQGLCDNLHC-----	2508
TRICHOPLAX	MYGIFMWIYDNYRQEIIDK--N--DETKQLINFCKDQLLQGLNDSSEEN-----	2505
NEMATOSTELLA	IYDIFMWVYDNYRSDYRNE--EGSEEILATAKDYLLRGLADDNKIL-----	2517
PRIAPULA	MYDILMWVYDSYRDESEG-----EEDKSLASLARDSLLQGLNDSDDL-----	2554
SOFTCORAL	MFDILWIYDNYRFDYRDETFKNEDSEGSEDLVLCRTKNVLLQGLADENKEM-----	2528
PISTILLATA	MYDIFIWIYDSYRADEAFQAE--EGSADILADAKDHLLQGLADHRDL-----	2555
HEMICHOR	MYDILTWIYDNYKDEES-ST-----AAEVLSTKEILLQGLSDEESYL-----	2553
BELCHER	MYDIMMWIYDNYREEAS-QQE--S-AGRVLGTAKDCLLQGLSDEESYL-----	2552
STRONG	MYSILMWIYDNYRDEDK-REG--QDGDEALSIAKDTLLQGLSDQDNYL-----	2549
STARFISH	MYDILMWIYDNFRDEES-RTE--DGADDILCMADKDTLLQGLSDEEASH-----	2563

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70450.1
ARCHAEON	DSNILDSISNDSIQKYISPAYWSKRS--PRKQIKQLIYEFFQGYYLINCVN---IGQGLH	2808
MUDCRAB	-----RQTVLNFWLERFQ-DMVLHDRVLIHI-LKMIYSPETEDSF-----	2518
SCORPION	-----RLTVHNFWSQNNHLP AETFSRIKAV-LQKMYSPEIEHMFSSDECFT	2527
SPONGE	-----KLKMYEYWNQESNLSNTLDRLTQL-LVTLYSKKTETQF-----	2584
CAPITELLA	-----RLTVQNFWSHETRLPGETVERLVAM-LEAMYTPSTELHY-----	2549
DANIO	-----OLYVRNFWSHESRLPPETLERMLVV-LKSLYSSRIEEQF-----	2564
MILII	-----OLYVRNFWGHENRLPTGTHDRMLAI-LRSMYSNKIETQY-----	2565
BAMBOO	-----OLYVRNFWSHENRLPTGTLDRMLAS-LGSLYCNKIETQY-----	2560
XENOPUS	-----QLIVRNFWSDETRLPSNTTERMLAI-LSSLYSPKIEKHY-----	2576
STERLET	-----OLYVRNFWSHESRLPTSTLERMLVV-LRSLYSSKIEAHY-----	2578
GAR	-----OLYVRNFWSHETRLPTTTLERMLVI-LRSLYSSKIEAQY-----	2567
LATIMERIA	-----OLYVRNFWSDENRLPVGTLDRMLVI-LKAFYCNKIETQY-----	2566
CAECIL	-----QLTVRNFWSDETRLPVVTTDRMLAL-LNSFYSPKIESHY-----	2568
SNAKE	-----QLIVRNFWSDETRLPTNTLDRMLSL-LRGLYSDKIETQY-----	2564
CANARY	-----QLIVRNFWSHETRLPTNTLDRMLSL-LSSFYSTKIEETHY-----	2557
OSTRICH	-----QLIVRNFWSDETRLPANILDRMLAL-LNSFYSTKIEETHY-----	2527
GECKO	-----QLIVRNFWSDETRLPGNTLDRMLTL-LSSLYSTKTETQY-----	2566
TURTLE	-----QLIVRNFWSDETRLPTNTLDRMLAL-LNSLYSTKIEETHY-----	2566
ALLIGATOR	-----QLVVRNFWSDETRLPTNTLDRMLAL-LNSFYSTKTETQY-----	2524
PLATYPUS	-----QLIVRNFWSNETRLPSNILDRLA--LNSFYSTKIEEMHY-----	2558
TASDEVIL	-----QLIIRNFWSHETRLPSNILDRLA--LRSLYSTKIEEMHF-----	2560
HUMAN	----- QLIIRNFWSHETRLPSNTLDRLA--LNSLYSPKIEVHF-----	2554
MOUSE	-----QLIIRNFWSHETRLPSNTLDRLA--LNSLYSPKIEVHF-----	2550
CRASSO2	-----RLLVQNFWSSETRVPGNTLDRLVAM-LEAMYSPVTEKQF-----	2546
POMACEA	-----RLTMQNFWSSESRLPDGTVDRMISI-LEAMYTPGSECNY-----	2546
TRICHOPLAX	-----RLQLINFWSNNNRLPSGTLERLSSV-LYALYSPNAESEF-----	2543
NEMATOSTELLA	-----KLKLQNFWSDETRLPNNTTLERLVDV-LRAMYSTNTEQQY-----	2555
PRIAPULA	-----RMIVTNFWSHATRLPTQTLPRLLAI-AQTLYSPATEPHF-----	2592
SOFTCORAL	-----RLKLRNFWSDETRLPNSTLERLVQV-LRAMYSPITESEY-----	2566
PISTILLATA	-----QLKLRNFWSDEARLPGTTLERLVEV-LRALYSTTTEIQY-----	2593
HEMICHOR	-----RLRVSNFWSHETRLPVGTLDRMVSM-LECMYSPDAENQF-----	2591
BELCHER	-----RLLVQNFWSHETRLPTGTLERLVAM-LECMHSPRTEPQY-----	2590
STRONG	-----RLRVSNFWSHETRLPKETLERLISM-LGCMYSPGTENRY-----	2587
STARFISH	-----RLRVSNFWSHETRLPTGTLERLVAM-LECMYSPGTEHQY-----	2601
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus “putative archaeon”

		RYG70450.1
ARCHAEON	GYIILLCKE-----LFDIKSVNNWLAYAPSLLL SVILQHPKNLEVLFNISLL	2855
MUDCRAB	-----LELAMYIILEATRYSDYQORDIFQHPLT	2546
SCORPION	LYISLIVDNFWSNEKRLPLGTVERLIALMKNMLQYSTFLLEMESKSPDYNLKI FQNPLS	2587
SPONGE	-----LYHATNLLL ELTSRSPDYNRVLFDTPLS	2612
CAPITELLA	-----LSYATNLLL EMTTKSSDFN RVLFDTPLS	2577
DANIO	-----LSLATDLLL EMTSHSPDFTRNMF EFP LS	2592
MILII	-----LSIATNLLL EMTSRSPDY TREMF EY PLS	2593
BAMBOO	-----LSIATNVLL EMTSHSPDYSREMF EY PLS	2588
XENOPUS	-----LSLATNLLL EMTSKSPDYIRKMF EHP LS	2604
STERLET	-----LSLATNLLL EMTSRSPDYTRDMF EY PLS	2606
GAR	-----LSLATNLLL EMTSRSPDYSRAIF EY PLS	2595
LATIMERIA	-----LSLATNMLL EMTSRSPDY TREIF EHP LS	2594
CAECIL	-----LSLATNFLL EMTSKSPDY TREMF EHALS	2596
SNAKE	-----LSLATNFLL EMTSKSPDYSRKM F EY PLS	2592
CANARY	-----LSLITNFLL EMTSKSPDYSRKIF EHP LS	2585
OSTRICH	-----LSLITNFLL EMTSKSPDYSRKM F EHP LS	2555
GECKO	-----LSLVTNFLL EMTSKSPDYSRKM F EY PLS	2594
TURTLE	-----LSLATNFLL EMTSKSPDYSRKM F EHP LS	2594
ALLIGATOR	-----LSLATNFLL EMTSKSPDYSRKIF EHP LS	2552
PLATYPUS	-----LSLVTNFLL EMTSKSPDYSRHIF EHP LS	2586
TASDEVIL	-----LSLATNFLL EMTSKSPDYSRHIF EHP LS	2588
HUMAN	-----LSLATNFLL EMTSMSPDY PNP MF EHP LS	2582
MOUSE	-----LSLATNFLL EMTRMSPDY LNP IF EHP LS	2578
CRASSO2	-----LSYATNLVLE MTSKSPDY QREMF ES PLE	2574
POMACEA	-----LSYATNLLL EMTSKSPDY DRQ IF EHP LS	2574
TRICHOPLAX	-----LSYSTNLLL ELTSRSPDY KLS IF DH PLS	2571
NEMATOSTELLA	-----LSYTTNLVLL HLT SFSPDFERLMF EQ PLS	2583
PRIAPULA	-----LSYATYLLL QLTSLSPDY KELV FTQ PLS	2620
SOFTCORAL	-----LSYTTNLLL HLT SQSPDFGRL IF EQ PLS	2594
PISTILLATA	-----LSYTTNLILL HLTSLSPDYERLMF EQ PLS	2621
HEMICHOR	-----LSYATSLLL EMTSKSPDY KREIF EHALS	2619
BELCHER	-----LSYCTNLLL EMTSRSPDF SREIF QHP LS	2618
STRONG	-----LGYATNLLL EMTSKSPDF KREIF EHP LS	2615
STARFISH	-----LSYASSLLL EMTSKSPDY KREIF EHP LS	2629
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70450.1
ARCHAEON	DNVTPTYQPLST-RSSRLTSSAGFSSSTPLFALERTSQSIQMLALQSPSIA-----K	2906
MUDCRAB	LCKFREMK-VSTAWRAR-----HASM-IPLFMDTOVSSDSSLRSLTQ-----SNEAEDDV	2594
SCORPION	TCAFQNYA-ISSSWKKR-----HATL-TPWVVDLSLSAASFSDTSV-----K	2627
SPONGE	ECRFEDYKEIDLSWQQR-----HLQM-TPLFAATQLSQTQSDTG-----S	2651
CAPITELLA	ECKFQDFA-VSSTWYQR-----HAAM-TPMFLDTQSSQSNDSPD-----AG	2616
DANIO	ECKFQDYT-IDSNRMR-----STVL-TPMFMETQATQGAEAAGSQ-----AA	2633
MILII	ECKFQDYN-IDSSWQQR-----STIL-TPMFVETOATQNSRSRSQ-----EGSLTAQG	2640
BAMBOO	ECKFQDYS-IDSSWHQR-----SRIL-TPLFVETOASAGSIKRSSQ-----EASTVDQN	2635
XENOPUS	ECKFQDYT-VDSSWRFR-----SSVL-TPMFVETQLSQSMQRSRAQ-----GTIEADE	2650
STERLET	DCKFQDYI-IDSNRHR-----STVL-TPMFVETOVTQGGTQYHTQ-----D---SPQG	2650
GAR	ECKFHDIY-IDSSWHHR-----NTVL-TPMFVETOASQGGSRYSR-----GGSASAQG	2642
LATIMERIA	ECKFQDYI-IDSNRHR-----STVL-TPMFVETOASQSTARFRSQ-----EGPEQVQG	2641
CAECIL	ECKFQDYT-IDSNRWYH-----STVL-TPMFVETOASLSASRYRSQ-----EGSFPAQS	2643
SNAKE	ECKFQDFV-IDSNWRYR-----STIL-TPMFVETRASQSA-----ITQEG	2630
CANARY	ECKFQDFV-VDSSWRFR-----STVL-TPMFVETOASPSTHRNLSC-----ERSLSPSG	2632
ONSTRICH	ECKFQDFV-IDSSWRYR-----STVL-TPLFVETOASQSTNRSLLC-----ERSPSTSG	2602
GECKO	ECKFQEFA-VDSSWRFR-----STVL-TPMFVETOASQNSPSRHRPP-----GGSLLTHG	2641
TURTLE	ECRFQDFT-IDSNWRYR-----STVL-TPMFVETOATQSAKRNRSC-----EGSLSTQG	2641
ALLIGATOR	ECRFQDFI-IDSNWRYR-----STIL-TPMFVETOASQASARKRSQ-----EGSLSTPG	2599
PLATYPUS	ECKFQEYT-IDSNWRFR-----STVL-TPMFVETOASQSALRSRSQ-----EGLLPQG	2633
TASDEVIL	DCKFQEYS-IDSDWRYR-----STVL-TPMFIETQASQNSTRNRSQ-----EGSLSLPR	2635
HUMAN	ECEFQEYT-IDSDWRFR-----STVL-TPMFVETOASQGTLOTRTQ-----EGSLSARW	2629
MOUSE	ECEFQEYT-IDPDWRFR-----STVL-TPMFIETQASPSILHTQTV-----EGPLSDQR	2625
CRASSO2	DCKFQDYN-VKSSWKQR-----HAAM-TPLFANTMATQSMDDD-----E	2612
POMACEA	ECTFRDYS-VQSSWRQR-----HAVM-TPLFAVTQGSQSETMEDVE-----D	2612
TRICHOPLAX	ECKFHDMY-VNYSWQYR-----HAMM-TPLFAATQLGSGQSMAS-----FSLSGSSS	2616
NEMATOSTELLA	ECKFEEYP-IDYSWQQR-----HVVM-TPLFAATQGSTQSHSQ-----GGSL-	2623
PRIAPULA	DCKFQDYN-IATSWQSR-----HAAL-TPLFTETQASQASSTQQTIV-----AAA	2662
SOFTCORAL	ECKFQDYE-INFQWQQR-----NSTM-TPLFVSTLMPSSGSSQSS-----FGSHSMDI	2639
PISTILLATA	ECRFEEYQ-IDYSWQKR-----HLAM-TPLFAATQSGSHGSGMTPIT-----Q----ESMSV	2665
HEMICHOR	ECKFEDYQ-IDHSWKRR-----HAAISTPMFVETOQSTQIGSDSQ-----SFIE	2661
BELCHER	ECRFQDVQ-IDHSWKQR-----HVAM-TPMFVETOSSHYPASSQSQA-----QSLSQGGQD	2666
STRONG	ACKFEGVQ-IDHSWRQR-----HAAISTPKFVETOQVGSQSGSI-RGSPSSQSMSTSSGMSM	2668
STARFISH	ECRFQDVT-IDHSWKQR-----HLAISTPMFVETOSSQASSGSQSQSPPPDS-----S	2675
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70450.1
ARCHAEON	KFAGCLSQG-LQTSIFGTSYTGEDRNMKYVKGTQQISWTQNSTSFDKSTLNYSYHKFAEP	2965
MUDCRAB	DGPRGVAAT--QANVFSATQQ-----TGGTFNWVTESTFDTS-LADMEYAAT---	2638
SCORPION	NIDEQIRST-VDVREFDPTQD-----QASKKAFNWLQTQTS-IDT-LGDWGSS-----	2671
SPONGE	IGTGMLRATVQQSLAFTPTQ-----GQESSYNWMTPSAQ----SVDYSVPSF--T	2695
CAPITELLA	LSTGQLRAT-QDAAQFTQQA----D---GSSKGPYNWLTQSS-LDT-FSDSQNL----T	2662
DANIO	TVRGQIRAT-QTSLEFSQILA-----PGAGRRSAYNWLGTGSS-VDT-LADYSLS----S	2680
MILII	TIGGLVRGT-QTHYEFPTQON-----PDAR-NFNWLTGNS-LDT-FAEYSLP----S	2684
BAMBOO	TIGGQIRAT-LTHYEFPTQON-----SGAR-NFNWLTGSS-LDT-FAEYTLF----F	2679
XENOPUS	PIGGQLRAT-QQHYQFTPTQON-----IGGRSSFNWLTGSS-MDT-LADYSVE----S	2695
STERLET	TIGGQVRAT-QAQLFPTQQA-----AGRRSSFNWLTGSS-IDT-LSEYSLP----S	2695
GAR	SLGGQLRAT-QSTLEFPTQD-----PGRRASFNWLTGSS-VDT-LSEYALP----A	2687
LATIMERIA	SLGGQVRAT-QVQFDFTPTQON-----TGIRSSFNWLTGSS-VDT-FAEYSLP----S	2686
CAECIL	SLGGQVRAT-QQOYEFPTQON-----IGGRNSFNWLTGNS-IDT-LAEYGVP----S	2688
SNAKE	YLGGLRAT-QQOFEFTPTQON-----ISGRSSFNWLTGNS-VDT-FTNSTVP----S	2675
CANARY	SVRGQVRAT-QRQYEFPTQH-----GSGRSSFNWLTGSS-IDT-LAEYAVP----S	2677
ONSTRICH	SGGGRVRVT-QQOYEFPTQON-----ISGRSSFNWLTGNS-IDT-LAEYMVP----S	2647
GECKO	SMGGQLRAT-QQOYEFPTQOT-----IGGRSSFNWLTGNS-VDT-FAEYSVT----S	2686
TURTLE	SLGGQVRAT-QQOYEFPTQON-----VNGRSSFNWLTGSS-IDT-LAEYTVP----S	2686
ALLIGATOR	SQGAQVRAT-QQOYEFPTQON-----MSGRKSFNWLTGSS-IDT-LTEYTVP----S	2644
PLATYPUS	LLLGQLRAT-QQOYEFPTQON-----TDGRNSFNWLTGSS-VDT-FTDYPGP----T	2677
TASDEVIL	LLTKQIRAT-QQOYEFPTQON-----IAGRNSFNWLTGSS-IDT-LADYTIP----S	2680
HUMAN	PVAGQIRAT-QQOHDFTLQOT-----ADGRSSFNWLTGSS-TDP-LVDHTSP----S	2674
MOUSE	QKPGQVRAT-QQOYDFPTQA-----SVERSSFNWLTGSS-IDL-LADHTVF----S	2670
CRASSO2	SYSGEIRAT-QDAQQFTALD-----ASKAPFNWLTGSS-LDT-FTDYSTV----	2655
POMACEA	SLRGGVRAT-VDVEQFTAME-----TGSNAPFNWLTQSS-LDT-FADASLM----	2656
TRICHOPLAX	TDEHLRATQSTNLQFTPTQD-----TDARNWLDPSSVDKS-IQSYAAFLOQSL	2664
NEMATOSTELLA	-EPGALRAT-QLRVEFSPTMD-----QSLSQAFDWLNPSSQADS-VQSFTV-----	2666
PRIAPULA	MQTGEIRAT-QVVPEFTATQ-----DVAGGRSTYNWLTQSSIDT-FADQSL----S	2709
SOFTCORAL	TDGGQLRAT-QNP-QFSMTQT---AGATGPTAQTYDWLNPSS-LDT-SQSS-SA----S	2686
PISTILLATA	DGSPGLRAT-QNL-QFTPTQD-----QRRSTAFDWLNPSTQ-ESN-LQPSQSF----A	2709
HEMICHOR	TIGNQVRAT-QDV-QFSATQ-----EVDGKKTAYNWLGT-S-QDT-FSEF-SS----S	2704
BELCHER	TLGGQLRAT-QDVLQFTATQ-----ASAAPKNAYNWLQTQSS-LDT-FADY-SV----P	2711
STRONG	GGGQLRAT-QATQNFATQ-----DNAASSHKNGYNWLGT-S-QDT-FADY-SS----S	2714
STARFISH	LSRGEIRAT-QDAHQFIATQQ----LDAVASRKNAYNWLGT-S-QDT-FADY-ST----S	2722

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70450.1
ARCHAEON	T-----GTTKLVSGAASSVA-----PLS---SFPFQTTVGGGISQP--GT--FS-MG	3006
MUDCRAB	HAPIHGSASGPMFNVGAHGKKNMRY-----KSSIGNTCMQPA-----ET	2679
SCORPION	-----STSSLLFTIGSDTKKIP-----NIDENNRNSN-----QDTSK	2704
SPONGE	VGATPTS DSSLLFTRPTMRPPLK-----NPLR-----ISAERLGKV--GE---SEG-	2736
CAPITELLA	LATQ--SESSL MFTV GSSRIKS-----SKKTPGSEFGQKVRSD-----VR	2701
DANIO	---DS--LSSLLVFDKRSERPQ-----AAWRAVGAGFGSKRLTAT--SD--DTDSR	2723
MILII	LASEP-GSSLLVFSRWSERLH----R----PAKKPVGPDFGKKRLALP--GD--EVDSK	2731
BAMBOO	S--ES-ASSLLVYSKRSESRQ----K----P-MKPVGPDFGQKRLAIP--GD--EVDAK	2723
XENOPUS	--PES-LPSALLFVNKR NENVR----R----VPLKPLGPNF GMRRLGLP--GD--VTDSK	2740
STERLET	S-ADS-VSSLLVFGKRGDKSQ----Q----AARKPVGSDFGKKRLGLP--GD--EVDSR	2741
GAR	T-SDS-LSSLLVFGKWGEKQO----QQQQRGPKKPVGADFGKKRLALP--GD--EVDSR	2737
LATIMERIA	S-SES-LASSLLAYGKRSEKSQ----R----AAMKPVGPDFGKRRALP--GD--EVDSR	2732
CAECIL	S-SES-LSSLLFASKKSEKSR----R----TSLKPLGPNF GKKRLGLP--GD--EVDSK	2734
SNAKE	S-SES-V--SMLLIKRTDRSY----K----TAFKPLSPNF GKKRQGLP--GD--EVDNK	2719
CANARY	S-SES-LSSMLLVSKRSEKFK----Q----ATFKPVGPDFGKKRLGLP--GD--EVDSK	2723
ONSTRICH	F-SES-LSSMLLVSKRSEKFK----Q----SAFKPVGPDFGKKRLGLP--GD--EVDSK	2693
GECKO	S-SES-LSSMLLTHKHADRSQ----R----AAFKPLGPNF GEKRLGLP--GD--EVDSK	2732
TURTLE	S-SES-LSSMLFVSKRSEKSQ----R----ATLKPLGPNF GKKRLGLP--GD--EVDSK	2732
ALLIGATOR	S-SES-LSSMLFVNKRSEKSQ----R----GTLKPVGPNF GKKKLGLP--GD--EVDST	2690
PLATYPUS	S-SES-LS-TLLFTHKKSSRTQ----K----AGFKPLGPNF GKKRVGLP--GD--EVDSK	2722
TASDEVIL	L-SES-LSSLLFVHKRTDKPQ----R----AAWKSVPNF GKKRLGLP--GD--EVDNK	2726
HUMAN	-----SDSLLFAHKRSERLQ----R----APLKSVPDFGKKRLGLP--GD--EVDNK	2715
MOUSE	--SET-LSSLLF SHKRTEKSQ----R----MSCKSVGPDFGTTKRLGLP--DD--EVDNQ	2715
CRASSO2	---GSETSSLLFTVGTQDMALRTGLK-----PKRKPGPGFGRPR-----AGASSKPAE-	2701
POMACEA	---ETNSLSSLLFTV GSSSKGADSKTRVATRRHHTGTGSNFGKQ MARTERTGNSAGPK--	2711
TRICHOPLAX	SSTSSETSTLLFLSSKSPRQR-----PLQ--MKPLSKDFGQQKLSSETA-S--QPQS-	2712
NEMATOSTELLA	--GSSEAQSLLF--GTKPRAS-----QRS--LKPVP HDFGSRRLAPTQS-D--SQA-	2710
PRIAPULA	VSSISSSSSSPYSSPSAD-HH-----ETPTEAK----RR--GATGE--EPRE-	2748
SOFTCORAL	FSVGS-QPSSLLFKSNPNMRRF-----KT---LRPQSEQPST-----SSAAQ--SDDP-	2728
PISTILLATA	MASTQ-TQSLLLFSTSQSHKRR-----KM---LKPVP GDFG SQKLSQASSR--ISSH-	2756
HEMICHOR	TGTET-SQSLLFTIGTTKKKA-----IT---RKPVSSGFGKDKMGAG--KD--QTDS-	2749
BELCHER	LGTE--TQSLLFTTDASKKVAKARR-----LKPVGPGFGSDRLSAG--RD--QTDG-	2757
STRONG	SS-A--SESSLFTMGS LPKRTAQGFRGVK-----QDAGAGSRD-----KEA-	2754
STARFISH	SA-S--DQSLLFTLGASKKM-GRGRQVVS---KTATDAGFGKEKLQSDQPRG--RDEV-	2772

Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70450.1
ARCHAEON	PPTSLSPRYMTTQRL LPV RFSAHSMQQAQSSIINKM-IYRRMTAEAAQNKHMSDVYNVDLH	3065
MUDCRAB	STTTDSGNIQSKL LRKR RFYKDQDREKQTIFFAKQEERRNKMRAATLEMERKLRREAQVTMY	2739
SCORPION	NKIEKLSSSNTFHL RRR RFLKDREK--SRLHFFIRMEMRKQQLRQEREKEQKKQREGQVTIY	2762
SPONGE	GETKEEKRKQVLQ LKKR ALKDKEM--VSSFFAMNEARKKMRREELKKQRRARQSYVVMY	2794
CAPITELLA	VSAMDEANKEIMRL LKR RFIHDQES--TARFFMKNVRMCKMREDIQREQMKREHQTMY	2759
DANIO	TAAERERRADILR RRR RFLKDKEK--ESIKFAKKEIHSQRTERRADLKIRQDAQVTLY	2781
MILII	TKGIVDQRADILR RRR RFLKDREK--VSLIFAKRGIREQRAEQKIKTEKRMERDAKVTLY	2789
BAMBOO	TKAVADQRADILR RRR RFLKDRQK--ENLIFARKSIOEKHLAKEMKTEQLKKRDAQVTLY	2781
XENOPUS	TK-SMEDRSDILR RRR RFLKDREK--LSLIYARKGTAEQKREKAIKIEQKMKQDAQITLY	2797
STERLET	TK-VKDQRADILR RRR RFLKDQEK--VSLIYAKKGVREQKQAKENVAEQKLRKREAQVTLY	2798
GAR	KKAVNDQRADILR RRR RFLKDQEK--VSLQFARKGIIQAQRQEKERAAEQTLRREAQVTLY	2795
LATIMERIA	TK-VADQRDLR RRR RFLKDQEK--VSLIYARKGVQIQKEEQKMAELKMKQDAQVTLY	2789
CAECIL	AK-GIDDRSDILR RRR RFLKDQGG--ISKIFVRKGVAEQKREKEITAERKMKRDSEVTLY	2791
SNAKE	SK-DTDEHTEILR RRR RFLKDKEK--LSLIYARKGVAEQKQEKIKTQLKIKHDAQITLY	2776
CANARY	TK-GIEERAEILR RRR RFLKDQDK--LSLIYARKSLAEQKREKEIKSELKMKYDAQVTLY	2780
OSTRICH	IK-GIDERAIEIL LKR RFLKDQEK--LSLIYARKGVAEQKREKEMKSELKMKHGDQVILY	2750
GECKO	TK-GIDERAIEILR RRR RFLKDQEK--LSLIYARKGVAEQKREKELKTELKMKHDAQVTLY	2789
TURTLE	AK-GIDERAIEILR RRR RFLKDQEK--LSLIYARKGVAEQKREKEIKSELKMKHDAQVTLY	2789
ALLIGATOR	TK-DINERAIEILR RRR RFLKDQEK--LSVIYARKGVAEQKREKEIKTELTMKRDAQVTLY	2747
PLATYPUS	TK-GIEERTEILR RRR RFLKDQEK--LSLIFAKKGVVEQKREKEIKSELKMKHDAQITLY	2779
TASDEVIL	TK-GIDERAIEILR RRR RFLKDQEK--LSLIYARKGVVEQKREKEMKNEKMKHDAQVTLY	2783
HUMAN	VK-GAAGRTDLLRRRRRFMRDQEK--LSLMYARKGVAEQKREKEIKSELKMKQDAQVVLY	2772
MOUSE	VKSGTPSQADILR RRR RFLKDREK--LSLLYAKRGLMEQKLEKDIKSEFKMKQDAQVVLY	2773
CRASSO2	RSRNEDQDSEMYR LKR RFLRDEEQ--TKTYFIKRHTRLEKMRREALREQKSRRREHQTMY	2759
POMACEA	NDNNTPEEDNVW LKR RFLKDRST--ASKYFARREIKEKSKREERLKQQLRRENQVTLY	2769
TRICHOPLAX	-QSVSQPSSSLNH LRRR YIKSEMA--NNAFYAKRERRKKQLREEILKQOKIARENKVVMY	2769
NEMATOSTELLA	TPAMGSQQQEILR LKR RFTKDSQT-KDRQYFIRMHEKKRQMLQQTQSRLKAARESQVVMY	2769
PRIAPULA	EASAAGGGDDVMR LRRR RFLKDQEQ--TRVFFARREARRKQRREEAETLSRQRREGQVXMY	2806
SOFTCORAL	SNENSSQLQNIR LKR RFLVVDREK--TDVYFAKKEIARQKLRTEVQRQKVARENKVVMY	2786
PISTILLATA	QSQDPNEKKEIL LKR RFLKDQSQ--ISAFFAKQALKRNKFRQALQRQKAAREGAIVVMY	2814
HEMICHOR	TEDTSQTDREIMR LKR RFLKDQEA--SRAFFARREIRLKKMREEAQKEQKLRHNMVTLY	2807
BELCHER	RAAEDSQQSEIMR LKR RFLKDQDV--TKAYHARRQIRMQKMRREERVKEQRAKRGNLVTLY	2815
STRONG	RKAPSEGEKEVQR LKR RFMKDQSS--QSFAKRAATRQKELREEVQKSQRERRFAQVTMY	2812
STARFISH	DAKQSGEDKKINR LKR RFLKDHSS--SQAYFARREMKRQQLKEKILEEQREKRFSTVTMY	2830

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70450.1
ARCHAEON	AEYRVGEAPDIAISAANLIKPLQTLCLYNPAASSQLLCLLLVSQYRSVDLVKEGIELIDC	3125
MUDCRAB	RQYRVGELPDIQIPHRALIAPLQALSQRDNKVAQLLFDVVVQAVVDNADSLMTRGEKDTW	2799
SCORPION	RQYRIGDLPDIEINYSSIIIVPLQALAQHDDDEICRMLFQSLILSVCCYMKSNQ-VTEYSEF	2821
SPONGE	RKYRMGELPDIQIKHSELI RPLQALAQNDISGLARLLFCSLFNSIFSQLDHLLTEEDAAAT	2854
CAPITELLA	RQYRTGDFPDIQIKYSFLIAPLQALAQRDSTIAKLLFVAVFQAI FTQIESEKTERESQSL	2819
DANIO	RSYRVGDL PDIQIQFSSLIAPLQALAQRDATLAKQLFSSLFAGVLVEMERLKS NKETADI	2841
MILII	RSYRFGDL PDIQIKYSSLIAPLQALAQKDHS LAKQLFSSALFSGILEEVHKS KTA-ETKDI	2848
BAMBOO	RCYRVGDL PDIQIKFSSLIAPLQAVAQKDHS LAKQLFSSALFSGILEEVRKSKTAAEMSGI	2841
XENOPUS	RNYRQGEL PDIQIISYSNLIAPLQALAQRDPTMAKLLFSSLFSGILTDTAS-----DISV	2851
STERLET	RSYRQGDLPDIQIQHSSLIAPLQALAQRDPTLAKQLFSSLFSGILIEMEKSKSQSEKKRI	2858
GAR	RRYRHGDL PDIQIIPYSSLI VPLQALAQRDSTLAKQLLSTLFCGILAQMEGSKNEAEKRRI	2855
LATIMERIA	RRYRQGDLPDIQIHYS SLIAPLQALAQRDPTLAKQLF SNLFTGILTEMEKSRSDSERKTI	2849
CAECIL	RSYRHGDL PDIQIAYS NLIAPLQAVAQRDPTLAKQLFSS LFFGIMKEMDKLKSSEM KDI	2851
SNAKE	RKYRQGDLPDIQIEYSSLI TPLQAVAQKDPTLAKQLFSS LFSGILEQMKKSKPLAERNNI	2836
CANARY	RSYRVGDL PDIQIEYCSLIAPLQGLAQKDPTFAKQLFSS LFGIFHEVKKSKHPSEKNAI	2840
OSTRICH	RSYRVGDL PDIQIEYSSLIAPLQGLAQKDPTFAKQLFSS LFTGILREVEKSKTPSEKKII	2810
GECKO	RRYRQGDLPDIQIEYSSLI TPLQGLAQRDSTLAKVLFSS LFAGILEEMRKSQSEKNSI	2849
TURTLE	RSYRQGDLPDIQIEYSSLI TPLQGV AQRDPLAKQLFSS LFTGILKEMNKFKNPSEKNCI	2849
ALLIGATOR	RSYRQGDLPDIQIEYSSLI TPLQGV AQRDPTLAKQLFSS LFTGILKEMENSKSPLEKTHI	2807
PLATYPUS	RSYRQGDLPDIQIEHSSLI TPLQAVAQRDPTLAKQLFSS LFAGILKEIDKFKSQSEKRNI	2839
TASDEVIL	RSYRQGDLPDIQIEYSSLI NPLQAVAQRD PVLAKQLFGSLFAGILKEMDKFKSPSEK KSI	2843
HUMAN	RSYRHGDL PDIQIKHSSLI TPLQAVAQRDPI IAKQLFSS LFSGILKEMDKFKTLSEKNNI	2832
MOUSE	RSYRHGDL PDIQIQHSGLI TPLQAVAQKDPI IAKQLFSS LFSGILKEMNKFKTTSEKNII	2833
CRASSO2	RKYRKGDL PDIQIKYSYIIAPLQAV AHRDSSVAKLLFGAIFKGIFSKMDEVKTEREVQET	2819
POMACEA	RRYRIGDLPDIQIKYSYIIAPLQAL AHRDNTIAKLLFGAVFKAIYQEMDKVKTDQEMEET	2829
TRICHOPLAX	RKYRDGEL PDIQIKHSELIAPFQAL AQVCYLDQNYRY---VNLSVNDLVENFNDEDAEET	2826
NEMATOSTELLA	RRYRAGDL PDVQIKHSELIAPLQAVA QCDSTLAKQLFSSLVQAILSQMDEKLTEQDAEKT	2829
PRIAPULA	RKYRIGDX PDVQIQFCHLISPLOAL AQRDARVAQLLFS SLCDGVRRAGDTATERDVDAT	2866
SOFTCORAL	RKYREGDL PDIQIKHSDLI TPLQALAQCD SYIAKQLFSGIFRGIFSQIDENVTD TQADEI	2846
PISTILLATA	RKYRS GDL PDIQIKYSELIAPLQAL AQCDNTFAKQLFSSALFRGIFSKIDEKLP EREAASV	2874
HEMICHOR	RSYRQGDLPDIQIKHMYLIAPLQAL AQRD TAIARQLFSS LFCGVFAQIAEEKTERESEEI	2867
BELCHER	RQYRVGDL PDIQIKYSYIIAPLQAL AQRD SMLARLLFSS LFRGIFEEIENVKTEREAEDL	2875
STRONG	RQYRTGDL PDIQIKHSDI IAPLQALALR DSTLSRLLFS S LFRGILARIGDMCTDGETELH	2872
STARFISH	RRYRTGDL PDIQIKYS DLIAPLQAL AQRDAS LARLLFSS LFRGIFSEIEEVKTEREAEST	2890

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70450.1
ARCHAEON	LCDILKQCQSC-SPTCILIPTILQVFIELSSCQPEFVKVLHAKLPDATVCQIALSCGCFH	3184
MUDCRAB	IQQLHSSVNVIANSYMCHPDMRLRTVLHLVINND--IL-----VSPDALAAACLGGHLEA	2852
SCORPION	CRSLSSALNEILKKSVDHYHPQLVAFCECLNCDVKEMD-----IDYEQICTASQASHKQS	2876
SPONGE	KGVIEGNINTILDCSTQYYPFFIGSLQDICYEN-SLK-----IKPPSITTSLSASKQEF	2908
CAPITELLA	VAKIESSLNKILETSTQYFSPFIGCVLEIAYLFPKQLK-----LQPGVVSTVCNMSDQQP	2874
DANIO	LKELVQTLNAFLNKSTVYFPPFISCIQDMSYHHKALLG-----VEPSLVSATCLASLQQP	2896
MILII	SKQLVENFNLYLLKATTLNFPPFVACIQDMSCKHDKLLG-----LDSTSVRSTSLASLQQP	2903
BAMBOO	GKELLLKHFTFLLNTTTLCFPPFVTCIQDMSCKHPDLLN-----LDPSIVSSTALVSLQQP	2896
XENOPUS	TDKLLKQFNFLSNLSYFPPFIACVQDMSYQHDELLH-----LNPANISTSCLASLQQP	2906
STERLET	TEEILGDMNFFLSKTTVYFPPFVTCVQDMSYRHKELLN-----IEPSSVSSSCLASLQQP	2913
GAR	TEELLQDMNHFLNKSTLYFPPFVTCVQDMSYQYKELLK-----VDPSAVSSSCLASLQQP	2910
LATIMERIA	LLELLGNFNGFLSNSTVYFPPFVTCIQDMSYQHAELLN-----LDPASVSASCLASLQQP	2904
CAECIL	TQKLLADFNRFLNITTSYFPPFVACIQDMSYHHTELLN-----LDPSNVSTSCLASLQQP	2906
SNAKE	IQQLLHDFNHFLTTSVLYFPPFIACILEMPTYLHEELLN-----LNCYSVSTSCLASLQQP	2891
CANARY	VQKLLNDFNFLSMLSIFPPFIACIQEMSYPHRELLN-----LDSANVSTSCLASLQQP	2895
ONSTRICH	IQQLLKDFNFSLSMSYFPPFIACIQEMSYPHRELLN-----LDSANVSTSCLASLQQP	2865
GECKO	IQQLVQDFNCFLLTTSVLYFPPFIACVQEMSYPHRELLN-----LNPSSVSTSCLASLQQS	2904
TURTLE	TQELLQNFNRFLSMTVSIFPPFIACIQEMSYPHRELLN-----LDSATVSTSCLASLQQP	2904
ALLIGATOR	VQKLLQNFDFLSISVSIFPPFISCIQEMSYPHRELLN-----IDSTSVSTSCLASLQQP	2862
PLATYPUS	TLKLLQDFNHFLSSTVSIFPPFISCIQEMSYPHRELLN-----LDANCVSTSCLASLQQP	2894
TASDEVIL	TEKLLDFNYFLSSTMLFFPPFISCIQEMSYPHRELLN-----LDSTTVSTSCLVSLQQP	2898
HUMAN	TQKLLQDFNRFLNITFSIFPPFVSCIQDISCQHAALLS-----LDPAAVSAGCLASLQQP	2887
MOUSE	TQNLLQDFNRFLNITFLFFPPFVSCIQDISCQHPDFLT-----LDPASVRVGCLASLQQP	2888
CRASSO2	IQQIQKSIGVVLTTSIQYFTPFIISCLLDVLYSLRSLK-----VDVSDVSSAAMFGNIQP	2874
POMACEA	KEKISDSLGRMLSTSIHYFTPFMGCVMDILHTLRSSLK-----VEVSELSIAAKISNLQP	2884
TRICHOPLAX	KAEIKASLSNIVKKSKEYFPPFIACVQDICYQOK-ELS-----IQSSFASVASLASSQQP	2880
NEMATOSTELLA	VTDIQGALDNIMTSTQFYFPPFISCIQEDICYHKS-MLK-----VQPSSVSTASLASLQQP	2883
PRIAPULA	MEKLLSEAVSVMASSTSYFSPFIGCLLDVCYRNISILR-----LDPAVVTTVSQTSMQQN	2921
SOFTCORAL	FRDIQDALNNMITSSTQYFPPFISCIQNVNCYNEG-KLS-----LEAGKVTTASIGSLQQP	2900
PISTILLATA	TSDLRSAMNHMLSSSTQFFPPFISSIQDICFHECKLRS-----VDSASVSTACLTSLQQP	2929
HEMICHOR	IKNINEHLNMLSNSTQYFSPFIGIEDIAYHNCKELM-----LDAQGISTASLISQQQP	2922
BELCHER	TEQISRFLNTALSNSKEYFPPFISSLQEICYREPRKLS-----PDASVIQQTGVISLQQP	2930
STRONG	VKGIERHLNQMLTDSNQFDPAFISCMLEIGFYHSEQLT-----LDPAAISQSCLTSRQLL	2927
STARFISH	KVEINRHLNMTLSTSTQYFPPFISCVQEISYYHSEQLT-----LVPSTISTASLTSQQMH	2945
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70450.1
ARCHAEON	IGIRYLEAKLNIIKNSTFAAGKALSAVSQDTAKSTGHSAKRRKGASSSAGIGNRSDTIDE	3244
MUDCRAB	LGVLVLERQVLLSQKG-----LGRDLPPPQKKLKT-----	2882
SCORPION	LGILLEDHILICYN-----NFKSSNPAKRIKL---N-----	2904
SPONGE	TGIMLLEKQLLLNV-----DS--SKSAKRSRT-----	2933
CAPITELLA	LGILLEEGLLHSP-----ED-QSPASKRSRR---DR-----	2902
DANIO	MGILLEESLLHGA-----GASEEPPLKRARG---KR-----	2925
MILII	MGILLEKSLIHST-----TN-EEPPTKKARG---RQ-----	2931
BAMBOO	MGIMLLESLMHL-----LP-EEPPAKRSRG---RT-----	2924
XENOPUS	LGILLEKGLLHMK-----VP-DEPPAKKMRKEKEKA-----	2937
STERLET	MGILMEESLIKGL-----VP-EEPPAKRARG---RR-----	2941
GAR	MGILLEESLIRGS-----VP-DEPPSKRARG---HR-----	2938
LATIMERIA	MGVLLLEQGLIQLL-----AA-EEPPAKRARG---RK-----	2932
CAECIL	VGILLERSLMSLV-----DT-EEPPRKKMRG---KT-----	2934
SNAKE	MGILLEQALVHLF-----PVEQQPPSKMRG---KT-----	2920
CANARY	MGILLERALMALS-----PA-EEPPSKMRG---RT-----	2923
OSTRICH	VGILLEHALISLS-----PA-EEPPSKRVCG---RA-----	2893
GECKO	VGILLEQALVHLS-----SEEEPPAKMRG---KT-----	2933
TURTLE	VGILLEQALTRLS-----SE-EEPLSKMRG---RA-----	2932
ALLIGATOR	VGILLEQALIHLS-----TI-EEPPAKRMCG---RT-----	2890
PLATYPUS	VGILLEQALIRLG-----PP-EEPSSKKRRG---KP-----	2922
TASDEVIL	VGILLEKALIHILT-----PA-EEPPSKMRG---KP-----	2926
HUMAN	VGIRLLEALLRLL-----PA--ELPAKRVRG---KA-----	2914
MOUSE	GGIRLLEALLRLM-----PK--EPPTKRVRG---KT-----	2915
CRASSO2	LGICVLEQLISQD-----E--DERPSKGRS---D-----	2900
POMACEA	LGIEVIEERLITED-----SG-GARPSKRSRY---D-----	2911
TRICHOPLAX	IGILLEKQIMHLD-----T--EEPPSKRIKT-----	2905
NEMATOSTELLA	MGILLEKQLLSQE-----A--EPKSHKRMRT---E-----	2909
PRIAPULA	LGIVLLEKMLMQGA-----CDDESRPAKRMRA---GS-----	2950
SOFTCORAL	TGIMLLEKQILQMA-----EDPGERPRKQKT---G-----	2928
PISTILLATA	IGIMLLEKQLEIE-----GK-SQNSRKRAKT---S-----	2956
HEMICHOR	LGILLLEEYLVQKS-----GE-EERSRKPRG---S-----	2949
BELCHER	IGIVLLEEQLVQKA-----GV-EEPRSKRART---S-----	2957
STRONG	IGIRVLEEVLIKKS-----GD-DERSRKART---S-----	2954
STARFISH	IGIRLLEENLIQKP-----WQ-EEKSAKRARF---V-----	2972
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70450.1
ARCHAEON	LFAQIETSTGDPAAAKNTVVTFDDVDSSSI FIQLMHL YDRLSEENIVNTLAEAVFLNDRS	3304
MUDCRAB	-----HLNSQLDTST WINMAEL YKNLSMWDVVRG IIH SKL----G	2918
SCORPION	-----KPLISDELS W L KMAE I YK SLSDYDS VHG IFSN S L----N	2940
SPONGE	-----NKSNEVTET WIELAR LYKS L EDYD V LHG I FTN L D----D	2968
CAPITELLA	-----SSRITQDTE WLELAK LYKS I SDYD V LRG I FSS Q I----G	2938
DANIO	-----ELPPDT--ER WIHLAK LYRS L GDYD V VRG I FSG K I----G	2959
MILII	-----ELPPD T DVAR WIELAT LYRS L GDYD V LRG I FSE K I----G	2967
BAMBOO	-----QLPPDT--AR WVELAK LYRS L GDYD V LRG I FSE K I----G	2958
XENOPUS	-----EIP P DI--VR WIELAK LYRS I GDYD V LRG I FSG K I----G	2971
STERLET	-----ELPPDT--AR WIHLAK LYRS L GDYD V LRG I FSG K I----G	2975
GAR	-----ELPPDT--ER WIHLAK LYRS L GDYD V LRG I FSG K I----G	2972
LATIMERIA	-----ELPPDT--IR WLELAK LYRS L GDYD V LRG I FSG M I----G	2966
CAECIL	-----ELSPDV--VR WIELAK LYRS L GDYD V LRG I FSG K I----G	2968
SNAKE	-----ELSPDV--TR WIELAR LYRS V GDYD V LRG I FSG K I----G	2954
CANARY	-----ELPPDV--IR WIELAK LYRS L GDYD AL RG I FSG K I----G	2957
OSTRICH	-----ELPPDV--IR WIELAK LYRS L GDS D VRG I FSG K I----G	2927
GECKO	-----DLSPDV--IR WIELAK LYRS V GDYD V LRG I FSG R I----G	2967
TURTLE	-----ALSPDV--IR WIELAK LYRS V GDYD V LRG I FSG K I----G	2966
ALLIGATOR	-----ELSPDV--IR WIELAK LYRS V GDYD V LRG I FSG R I----G	2924
PLATYPUS	-----QLPPDV--VR WIELAK LYRS V GEYD V LRG I FSG E I----G	2956
TASDEVIL	-----QLSPDV--IK WIELAK LYRS I GEYD V LRG I FSG E I----K	2960
HUMAN	-----RLPPDV--LR WVELAK LYRS I GEYD V LRG I FT S E I ----G	2948
MOUSE	-----CLPPDV--LR WMELAK LYRS I GEYD V LRG I FSS E L----G	2949
CRASSO2	-----NAVVSTDTLS WIELAR LYKS V KEYD V LLG I FSG R I----G	2936
POMACEA	-----VTPVTKDDM QWIELAK LYKS L GEF D V LHG IFSG M L----K	2947
TRICHOPLAX	-----SSASEATSN WIELSK LYKS I GYD V LRG I FSG H L----G	2940
NEMATOSTELLA	-----HSPSSDTTAA WLELAK LYRS V EEF D V LHG IFSD H I----G	2945
PRIAPULA	-----GMGVSQHTDT WIELAR LYKS L GDYD T LHG I FND K I----G	2986
SOFTCORAL	-----GNPSP E STAT WIELSK LYKS V EDF D V LQ G I FNS H I----G	2964
PISTILLATA	-----TVPPSEV TTCWIELSK LYRS V GDYD V LRG I FT G H I ----G	2992
HEMICHOR	-----ASLLSQE ISTWIELSR LYKD L DNF D V LRG I F SG K V----G	2985
BELCHER	-----SSP V SA E TAT WIELAR LYKS L GDF D V LQ G I FS R K V ----G	2993
STRONG	-----RPES NQ EM STWIELAR LY KAM GEF D V LRG I F G AL I----K	2990
STARFISH	-----SREPS E IST WIELAR LY KAL GDF DA V Q G V FS AC I----G	3008

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70450.1
ARCHAEON	SDEAAAQMK E AID Y EARG E F T S A VEV Y NSLLRGI-GSNSGSQ L TGPCKKR N FAASQLDAS	3363
MUDCRAB	R--IKPETRE A LE A EAT N DSVQ A F I I Y RTAL N T--QWPE--EP-----	2955
SCORPION	I---QE E TKQ A LE F ESR G E Y LL A V K I Y SKLYD Q T-EWS A E-EP-----	2978
SPONGE	T---KDV T R K AL E A E ER G D Y L T AL N L Y KK A ID F --DWPQ G ES P -----	3006
CAPITELLA	S---KP A TRL A IE A E T R G D Y RS A L Q L Y NE S L A KE-EWDD G EH P -----	2977
DANIO	T---KS I T F T A L Q A E AK S D Y A E AV K L Y NE A L N KE-DWDD G -EP-----	2997
MILII	T---K P L T H T AL L A E AK S D Y A E AV R L Y D Q AL N TE-EWMD G -NP-----	3005
BAMBOO	T---K S T T Q K AL L A E AK S D Y A E AV Q L Y D Q AL N TE-EWVD G -NP-----	2996
XENOPUS	A---KS I T Q CAL N A E AK S D Y AK A AK L Y D EAL T -E-T F SD G -D P -----	3008
STERLET	A---KS I T S MA L Q A EAK S D Y A E AV K L Y NE A L N TE-EW T D G -EP-----	3013
GAR	A---K P V T SL A L Q A E AK N D Y S Q AV K L Y NE A L N TE-EW M D E -G P -----	3010
LATIMERIA	T---K Q V T Q K AL L A E AK S D Y SE A V R L Y D E AL N VE-EW P D G -EP-----	3004
CAECIL	T---K P H T K D AL L A E AK S D Y A T A A K L Y D EAL N M P -D S W S N D -EP-----	3006
SNAKE	T---NE I T H NAL L A E AK S D Y A E AV K L Y D K AL S I Q -DW P G D -EP-----	2992
CANARY	T---KE I T Q KAL L A E AR N D Y A E AA Q Y D KAL S I Q -DW P D G -EP-----	2995
OSTRICH	T---KE I T Q KAL L A E AR S D Y A T A A K H Y D EAL S K E -DW Q D G -EP-----	2965
GECKO	T---KE V T Q KAL L A E AN S D Y A E AA K Q Y D E AL S K Q -DW P D E -EP-----	3005
TURTLE	T---KE I T Q NAL L A E AR S D Y A E AA K Q Y D E AL S K Q -DW P D G -EP-----	3004
ALLIGATOR	T---KE I T Q KAL L A E AK S D Y VE A V K Q Y D E AL S K Q -DW S D G -EP-----	2962
PLATYPUS	T---K H V T Q I AL L A E SK S D Y SE A AK Q Y N EAL N M Q -H W E D G-EP-----	2994
TASDEVIL	T---K P V T Q N AL L A E AK N D Y SE A AK Q Y N EAL N T Q -E W L E G-D P -----	2998
HUMAN	T---KQITQSALLAEARSDYSEAAKQYDEALNKQ-DWVDG-EP-----	2986
MOUSE	T---T Q D T Q N AL L A E AR S D Y C Q AA K L Y D E AL N K L -E W V D G-EP-----	2987
CRASSO2	T---Q D I T K E AV Q M E AR G D Y Y K AV K L Y N Q AL S C N -D W D E --N P -----	2973
POMACEA	T---KE V T Q L A L I E S H S E Y K A A I A L Y N K A L E S A -D H D P --R P -----	2984
TRICHOPLAX	T---K D I T Q R AL E A E SR H D Y AA A V K Y N Q A M D C S -S W P D G-EP-----	2978
NEMATOSTELLA	T---K P I T R L AL E A E AR G D Y A Q A L K I Y N E A M S C D -D W S S --K P -----	2982
PRIAPULA	T---Q T C T Q E AL Q A E AS C D Y K L A R K L Y Q R A L E -M-E W G E S E G P -----	3024
SOFTCORAL	T---Q S I T K D AL E A E GR G D Y T E A L K L Y S Q A T N C D -E W P A G S S P -----	3003
PISTILLATA	T---K D I T R E AM E A E AR G D Y S Q A L K L Y N E A I G T D D V W I K E -E L -----	3031
HEMICHOR	T---Q P V T R E AL E A E AS A N Y Q K A A N L Y D EAL G C T -D W P D G-R P -----	3023
BELCHER	T---Q T V T Y E AL E A E AR G D F K K AV E L Y N Q A M Q E T-E W P D P-Q P -----	3031
STRONG	T---K D V T Q E A I Q A ES R G D Y E S A L E L Y S K A I S-S-D W G P D-G V -----	3027
STARFISH	T---H E I T K T AL E A E AR G D Y S T A L K L Y N Q A F E -M-D W D E G-A V -----	3045

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70450.1
ARCHAEON	SLGQGQVLGLLVGRSLECYHKLASWESLYSCTAY-LFEG-SGVVDRMDLDGESAQRVLS	3421
MUDCRAB	---DPAEVHLWEECYASCAAKLGQWSELENFVENRLKDEAGQVSLN-----QVWTL	3004
SCORPION	---NQAEIDLWDNAILQCYDYLTQWDLQLQSLIIN-RLDENQKQPNLN-----KIWEE	3026
SPONGE	---PQVEEDLWEDSLLNAYSHLTKWKDLEKASTC-NIGE-ETNSKLE-----QLWKD	3053
CAPITELLA	---TEAEINMWDSRIECAENLTQWRDVETLSTS-DLE----GSSLS-----AVWDS	3021
DANIO	---TITEKDFWEIAALEAYNHLEWKSLEYCATV-NIDD-SSPIRLD-----RMWTE	3044
MILII	---METEKDFWEIAALECYNHLEWKALEYCSTV-NIDD-KTPADIE-----NIWSD	3052
BAMBOO	---TDAEKDFWDIAALECYSHLEWKSLEYCSTV-NISD-KTPVDLE-----DIWTD	3043
XENOPUS	---TDAEKDFWELASLECYNHLEWKPLEYCSTV-NIDT-GKPPDLN-----KMWSD	3055
STERLET	---AEAEDLWEIAALESYSHLEWKSLOQCSTV-NIDD-SSPADLE-----KIWGD	3060
GAR	---TDTEKDFWEIAALECYNHLEWKSLOQCSTV-NIGD-SSPVDLE-----KMWSD	3057
LATIMERIA	---TEAEKDFWELAALCYSHLEWKALEYCSTV-NIDD-KTPADLE-----NIWND	3051
CAECIL	---TEAEKDFWEVAALCYNRLTEWKPLEYCSTV-NIDD-SKPADLN-----KIWND	3053
SNAKE	---TEAEKDFWKIASLECYNHLEWKSLEYRLTV-NIDN-GQPADLN-----KIWSD	3039
CANARY	---TEAEKDFWELASLECYDHLTMWKSLEYCATV-NIDS-GKPPDLS-----KTWND	3042
OSTRICH	---TEAEKDFWELASLECYDHLTEWKSLEYCATV-NIDS-GQPADLN-----KTWND	3012
GECKO	---IEAEKDFWEFASLECYDHLTEWKSLEYCSTV-NIDD-KQPPDLN-----KTWSN	3052
TURTLE	---TEAEKDFWELASLECYNHLEWKSLEYCSTV-NIDS-GQPPDLN-----KTWSD	3051
ALLIGATOR	---SEAERDFWELASLECYDHLTEWKSLEYCSTL-NIDS-EQPADLN-----KTWSD	3009
PLATYPUS	---SEAEKDFWELAVLECYNHLEWKSLEYCSTV-NIDS-ESPPDLN-----KIWND	3041
TASDEVIL	---TEAEKDFWELAALCYNHLEWKSLEYCSTI-NVDS-ENPPDLS-----KMWSE	3045
HUMAN	---TEAEKDFWELASLDCYNHLAEWKSLEYCSTA-SIDS-ENPPDLN-----KIWSE	3033
MOUSE	---TEAEKEFWELASLDCYNNLSKWKELEYCSTV-NIVS-ENSLDLS-----KMWSE	3034
CRASSO2	---PTIEVDMWDESRMECLDNLSQWKELEGVAMS-GIS----SNSIS-----QVWKD	3017
POMACEA	---LEAEIDLWDESRMECLNRLTEWTKLEMVTTD-ALSQ-EGEISLA-----SVWDD	3031
TRICHOPLAX	---QAEEDLWEISRLECLYNLTQWDKLEYLSLV-NVD-NNDPPSFD-----KIWED	3025
NEMATOSTELLA	---QQQEEEDLWDDARMQCFANLAKWGDLEEYSKT-GVDDEGNPPDL-----KIWTD	3030
PRIAPULA	---GQGERDLWDISLMQCLDRLTDWTALDAHTKECLIPESSEADLQ-----LLWED	3073
SOFTCORAL	---LQAEEDFWDDSILECCRRLTLWDKMDHNCIV-NFDEANGVLDLN-----QIWRD	3051
PISTILLATA	---RQEEEDLWDDVSRQLCLADLTKWKELEKCSVE-SIDD-KNPPDL-----KVWSD	3078
HEMICHOR	---EQVEEDLWDDCRLQCYEQLTDWQKLEQASTI-NIDD-NDPPDL-----KIWDD	3070
BELCHER	---LAVEEDLWDDSRQLQCYDHLTQWKNLYEVSTV-NIDE-DSPPNLD-----KMWDD	3078
STRONG	---AREEEDFWDEARLQCCNQLTKWDDMESFSTD-QIEG-KGSNDLS-----QIWND	3074
STARFISH	---SQVEEDLWDESRLNCCNQLTQWKELOQNYSTV-NIDD-NSPHDLG-----KIWSD	3092
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70450.1
ARCHAEON	FVLNQSLADEDRAAHLRRTAASYLRSFIHLSFPLLEKPLAMQSRAFLATQLIALK----	3477
MUDCRAB	P-----R-----PAVSVLPSIVNSKLM-----ILDGSE-TDRNLNAFIDSALGEPNH	3046
SCORPION	P-----Y-----YQENYLPFLIKSKLKL----LIENR--NDQSLLCFIDSALKEENK	3067
SPONGE	S-----Y-----CQEHYLPFVLSKSKLKL----WCTDD--SDHGLASFLDKSLSEEAN	3094
CAPITELLA	T-----Y-----HQEVYLPPLRSKIKL----ILNGDT-SQDNLLSFIEESLKTPVH	3063
DANIO	T-----F-----YVETYLQYMMRSMLKQ----LQMG--TNQDLLSFVDAAMKTEEH	3085
MILII	T-----F-----YQETYLSYMIIRSKVKL----LQSGE--VDQSLLTFFVDRAMKVEQR	3093
BAMBOO	P-----F-----YMEAYLPHMIRSKVKL----LQLGE--NDQSLLTFFVDNAMKVDQR	3084
XENOPUS	P-----F-----YQETYLPYMIIRSKLKM----LLGGN--NDQTLTFFVDEAMKVEQR	3096
STERLET	P-----F-----YQEAYLPYVIRSSVKL----LQLGE--PDQSLLTFFVDNAMKVEER	3101
GAR	P-----F-----YQEAYLPYVIRGMVKQ----LQLGG--QDQSLLTFFVDNAMKVEER	3098
LATIMERIA	P-----F-----YQETYLPYLMIRSKVKL----LLGQ--GDQSLLTFFIDNAMKVEER	3092
CAECIL	P-----F-----YQETYLPYMIIRSKVKL----LLQK--DDQSLLTFFIDNAMKVEQR	3094
SNAKE	P-----F-----YQEAYLPYVIRSKLKL----LFHGG--SDQSLLTFFIDEAMKAEEK	3080
CANARY	P-----F-----FQETYLPYIIRSKLKL----LLSGE--NDQTLTFFIDEAMKTEQK	3083
OSTRICH	P-----Y-----YQETYLPYIIRSKLKL----LLNGE--NDQTLTFFIDEAMKTEQK	3053
GECKO	P-----F-----YQETYLPYIIRSKLKL----LLHGG--DDQSLLTFFIDEAMKTEQK	3093
TURTLE	P-----F-----YQETYLPYIIRSKLKL----LLHGG--NDQSLLTFFIDEAMKIEQR	3092
ALLIGATOR	P-----F-----FQETYLPYIIRSKLKL----LLHGG--SDQSLLTFFIDEAMKIEQR	3050
PLATYPUS	P-----F-----YQETYLPYMIIRGKLLK----LLQGG--SDQSLLTFFMDEAMKKEKQ	3082
TASDEVIL	P-----F-----YQETYLPYMIIRSKLKL----LLQGA--SDQSLLTFFIDEAMKKEPQ	3086
HUMAN	P-----F-----YQETYLPYMIIRSKLKL----LLQGE--ADQSLLTFFIDKAMHGELQ	3074
MOUSE	P-----F-----YQETYLPYVIRSKLKL----LLQGE--GNQSLLTFFVDEAMNKELQ	3075
CRASSO2	T-----Y-----YQEHYLPYIIRSKVKL----MLQGDG-DQQPLLTFFIDDCMKQTEQ	3059
POMACEA	T-----Y-----YMETYLPYLIRSKLKL----LLHGDE-KQQSLLSFIDDSMKNPQH	3073
TRICHOPLAX	N-----Y-----YQENYLPFLKSKAKV---MCENDLAGSDDFIQYLNKSLANDEH	3068
NEMATOSTELLA	T-----Y-----LQEHYLPFIMRSSIKL----ICEGEE--RPCFLEFLRHSMNNEER	3071
PRIAPULA	T-----Y-----YEENHLPFVMRARLKR----LLVEG-ARDQTLTFFVDAATGHPDR	3115
SOFTCORAL	D-----Y-----YKEHYLPFLCSTKTK----FCIGD--RDEVFFNFIFDSLKNEER	3092
PISTILLATA	T-----F-----YQEHYLPHLITSKLKL----QCQGS--GDMTLNEFVAKAMKTSER	3119
HEMICHOR	T-----Y-----YQEHYLPYVIRSKLKL----LMEDDDTDDQSLLTFFIDKSMQHKER	3113
BELCHER	T-----Y-----FQEHYLPFTIRSKLKL----LLEGE--MDQSLTFFVDSAMQKPDR	3119
STRONG	D-----Y-----QQEYLPYMMIRSKLKR----LMEGS--EDDSSLGFIDSAMKQEK	3115
STARFISH	T-----F-----YQELYLPYMMIRSKLKL----LMEGG--EDETLLQFIDASMSDADK	3133

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70450.1
ARCHAEON	SNHSASLSSLDLAASHILLEDDYQASLAMKDAVSTFLNKF T MLHAVAYKG--KAGLLLSL	3535
MUDCRAB	RNLESTLPLPLAIMSAHQQKMAQARHYITLATSKVLLTLAQSSLLTPKP--LTGTVRDI	3104
SCORPION	KKYLEENFSEELALLYIIQENYDRAQYYSQLCLQDFLKEWSSLNVLMPII--RKTQLQSL	3125
SPONGE	RSVLESHYPQELT T LSYVLRDDYDRA Y YYLSLSL K AKQ Q IW S VQDGISSSTGAVSSTVQSL	3154
CAPITELLA	KAFIEGSFSSELALVCIHQELYDKAKHYANMSLQAFIQDWANLSTTRTST--RATKLQKL	3121
DANIO	KIIMETHYSQEL S LLYILQEDYDRA K YYANNCM Q VFMQNY S SIDPLLNRS--RLTVLQSV	3143
MILII	KAVIETYYSQEL S LLYILQDDVDRA K YYINNCMEVFMQNY S SIDTLLHQS--RLTKLQSL	3151
BAMBOO	KTVIETRYSQEL S LLYILQDDFDR A KYYVNNSIQSFMQNY S SIDPLLHRS--RLTKLQSL	3142
XENOPUS	KVLMETFYSQEL S LLYILQDDFDR A KYYINNGIQVFMQNY S SIDCLLYQS--RLTKLQSV	3154
STERLET	KSIIETSYSQEL S LLYILQGDFDR A KYYVNNCM Q VFMQNY S SIDTLLPGS--RLTKLQSV	3159
GAR	KSVMETNYSQEL S LLYILQDDYDRA K FYINNSMQVFIQNY S SNIDALLYGS--RLAKLQSV	3156
LATIMERIA	KALLETHYSQEL S LLYILQDDFDR A KYYVGNCM Q VFMQNY S SIDTLQHKS--RLTKLQSV	3150
CAECIL	KALLETNYNQEL S LLYILQDDFDR A KYYIDNGIQVFMQSH S SIDTLLNKS--RLTKLQSV	3152
SNAKE	KALIEMYYSQEL S LLYILQDDFDR A RYVKNAM Q VFMQNY S SNIDSLFNS--RMIKLQSV	3138
CANARY	KAIIEMHYSQEL S LLYILQDDFDR A KYYISNGM Q IFMQSY S SIDSLLYQS--RITKLQSV	3141
OSTRICH	KAIIEMRYSQEL S LLYILQDDFDR A KYYISNGL Q IFMQSY S STD T LLHQS--RMTKLQSV	3111
GECKO	KALIEMYYSQEL S LLYILQDDFDR A KYYISNAM Q VFMQNY S SIDSVLHQS--RLTKLQSI	3151
TURTLE	KALIEMYYSQEL S LLYILQDDFDR A RYIISGM Q VFMQNY S SIDTLLHQS--RLTKLQSV	3150
ALLIGATOR	KALIEMHYSQEL S LLYILQDDFDR A RYIISNGM Q VFMQNY S SIDALLHQS--RLTKLQSV	3108
PLATYPUS	KTLEIETHYSQEL S LLYILQDDFDR A KYYIDYCI Q IFMQNY S SNIDALLQS--RLTKLQSV	3140
TASDEVIL	KTLEIEVHYSQEL S LLYILQDDFDR A KYYIENSI Q VFMQNY S SIDALLHQS--RLTKLQSV	3144
HUMAN	KAILELHYSQELSLLYLLQDDVDRAKYYIQNGIQSFMQNYSSIDVLLHQS--RLTKLQSV	3132
MOUSE	KTVLELQYSQEL S LLYILQDDIDRA T YYIKNGIQIFMQNY S SIDVLLYRS--RLAKLQSV	3133
CRASSO2	KALIESRYSEELALMYIWQADYDRA R HYSTLAT Q QFLLDW S STD S LM S VS--RKS Q L Q RL	3117
POMACEA	RAHLESRYCEDLALMYVWQKNFDL A RHYARLAV Q SFFQDW S STD S LM T AS--RTH C L Q RL	3131
TRICHOPLAX	LSVLENRHCDCLALIHVLEKYDRA R YYLDFSI Q KFLQDW S ALDSTLLYS--RASKLQSL	3126
NEMATOSTELLA	KAFLESRYGDDLALLFILRDDYGRA R YHVTNCF Q AFLKDW S GLSSMMVSS--RASKLQSI	3129
PRIAPULA	RAVIETWHGEEALALLYIVQGDYTRA R HHAARCL Q AFLRDW A SLDALMLAS--RAARL R SL	3173
SOFTCORAL	KVYLENKYS D LALLFILDEDYDRA R YYTSICL Q AFL E DW S GLDSIMTSS--RSAHL Q SL	3150
PISTILLATA	AALLRSRYSDSLALMYVLQDNCDS A SYAALSE Q SFLSDW A GLDSNLRSS--RSIKL Q SL	3177
HEMICHOR	KALIENRYSEALAMLYLLQDDYDRA R YYTANCI Q SFLQDW S GTDTLMGTI--RSSKL Q CV	3171
BELCHER	KALLESRYCEELAMLYLYQDDYGRA K YYVGNC T DAFLQEW S GMDRLMTSS--RAAKL Q SL	3177
STRONG	RVILESRYTEELAALSILKEDYNRA K YYLANST S SFLQEW S GLGPLMLTS--RLSKL Q DI	3173
STARFISH	RAFLEARYSEELSTLYTIQEDYDRA M FYLANCR Q SFLHDW S GLGPLMISS--RRAKL Q CI	3191
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus “putative archaeon”

		RYG70450.1
ARCHAEON	QRMNELRDFIFYNTQ-QAYIASKISAMQGLANSTGQOKKIALNNLEDDIIKAWTLSEPNI	3594
MUDCRAB	QLVTELGEFLETLDY-THNEN-----YPNKVRKTVKNWKTQETCL	3143
SCORPION	QKHIELQEFLNFDIT-YRNI-----DEYHFKNLTDRLWKRYPDI	3163
SPONGE	QRLTEMNEFITFMKS-NDNFSSP-----G--PVNNLLRKWRKRFPDP	3193
CAPITELLA	QEFTEMQEFLSVIKTTSG-E--D-----FPRQIDRTLHKWEARSPDR	3160
DANIO	QALTEIQDFLNYITG-DV---SV-----N--SLKFMIRRWTSHPDA	3179
MILII	QAVTEMQDFLHFISK-EYNFISE-----V--PLRKLRLRTWTGRYPDA	3190
BAMBOO	QTLTEIQDFLHFITK-GSNLTSE-----V--PLRKLVRTWIGRYPES	3181
XENOPUS	QALTEIQDFISFIRK-PGNVSS-----S--SLRKLQFGWMKRYPDS	3192
STERLET	QALTEIQDFLNFMTK-DV---SQ-----T--SLKSLIRIWTDRYPDA	3195
GAR	QALTEIQDFLYFITK-DV---ST-----A--SLKTLIRTWTHRYPDD	3192
LATIMERIA	QALTEMQDFLGFISK-PDHLNSR-----A--SLRLLRNWSDRYPDA	3189
CAECIL	QALTEITKDFIHFISK-PSNLTSQ-----T--SLKRLLRIWSSRYPDS	3191
SNAKE	QALTEIQDFINFMSK-ESSLTFQ-----A--SLKRLLNIVRSRYPDT	3177
CANARY	QALTEIQDFINFMTK-RSNLASE-----A--SLKRLRLRTWTSRYPDA	3180
ONSTRICH	QTLTEIQDFIHFMTK-TSNLASQ-----A--SLKRLLRIWTSRYPDA	3150
GECKO	QTLTEIQGFVNFISR-SGNIASQ-----A--SLKRLISIVMSRYPDS	3190
TURTLE	QALTEIQEFINFISK-PSSLASQ-----V--SLKRLLRIVRSRYPDD	3189
ALLIGATOR	QALTEIQDFINFMRE-PSNLASQ-----A--SLKRLLRIWTSRYPDA	3147
PLATYPUS	QALTEIQDFTNFISR-PSNLSSQ-----A--SLKRLLRIWTRYPDA	3179
TASDEVIL	QALIEIQDFVNFMSK-QGNLSSQ-----A--PLKRLLRIWTRYPDA	3183
HUMAN	QALTEIQEFISFISK-QGNLSSQ-----V--PLKRLLNTRWTRYPDA	3171
MOUSE	QTLAEIEEFLSFICK-HGDLSSL-----G--PLRLLKTRWTRYPDV	3172
CRASSO2	QPLVELQEFLSFMAS-EGNFTSV-----T--PANSLIERWQARALHP	3156
POMACEA	QPLLELQEFLDVAD-KNNFTSF-----E--PSHQLIARWEQRYPHV	3170
TRICHOPLAX	QTLTEMQEFLQFMDD-GRNFESV-----T--PVLSLISKWSTRFPNE	3165
NEMATOSTELLA	QKITEMQEFLEFVVK-EGKLLK-----K--TLEDLFSRWSVRFPS	3167
PRIAPULA	QKLTEMNEFLDAITATPDFAFTRN-----D--TARALVDRWMDHMPHP	3213
SOFTCORAL	QALTEMQEFLDFISH-EDNFSTI-----S--SVKSLLKRWSSREPDP	3189
PISTILLATA	QKITEMQEFLEFIAE-EGNF--S-----SPMPVLSLLNKWYSRLPHP	3216
HEMICHOR	QKLEMQEFLTFITN-ERNFDEH-----K--PVSDLISKWTKRPLDV	3210
BELCHER	QKLTEMQEFLELISN-DRNF--E-----TPWPVTRLLEKWSSRYPDN	3216
STRONG	QKLTEAEQFLQLANK-PFSEGLK-----S--SATRLVSDWSRNLDPD	3212
STARFISH	QRLTEKQNFLLKLAIK-PDLQEA-----GCQKSLELLDRWSGCHLDS	3232
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70450.1
ARCHAEON	-FDPLHHWSDVIWTRSLMLQKLADSNQDAQ-----LSAKG-----AEH	3633
MUDCRAB	-TDSSVLMQFLSSHRELYFQFLEKELPQD-----CLED	3175
SCORPION	-FDSVNIWDDIIMNRSLYMEKIVSKLQETNNQ--STSFSLLEESMDTS--IVDSEPNSYFD	3218
SPONGE	KLDPVPIWDDIITTRWMLLRKISTKLQDSVLS-QQCEYLLDDDG-----SSCS	3240
CAPITELLA	LLDSVVIWDDNIILNRNVYMDHFAEHLTSDAK-----	3192
DANIO	KLDPMNWDDIITSRCFFLDKILKRLKST-----PENSMSEVDGADQG-----SGEE	3225
MILII	KMDPMSIWDDVITNRCFFLDKIQRVLSV-----QADESMSEVDREGEVETRMEVDKEEED	3245
BAMBOO	KLDPMSVWDDVITNRCFFLDKIKERLSLL-----QADDSMEVDDEGA-ETQMDIDKEEDD	3235
XENOPUS	KMDPMNIWDDIISNRCFFLDKIQDVAVGHPQ---LVDESMSEVDDLADGNEAMEVDR-QED	3248
STERLET	KMDPMNVWDDIITTRCFFLDKIAGKLTNS-----EADNSMEVDGGEDTGVKMEVDE-PED	3249
GAR	RMDPMNVWDDVITNRCFFLDKISEKLVSS-----VAGDSMEVEEDGDKEIKTEAGE-WED	3246
LATIMERIA	KMDPVNIWDDIITNRCFFLDKIQEHLCKV-----PADESMSEVDGEGDASPRMDVDE-EPN	3243
CAECIL	KMDPMNVWDDIITNRCFFLDKIREKLPHF-----QADDSMEVDGGGDASDRMELGGEEED	3246
SNAKE	KMDPMNIWDDIITNRCFFLDKIQEKFSS-----HLDDSMELDGDAT--FSMEIDNENQD	3230
CANARY	KMDPMNIWDDIITNRCFFLDKIQEKLPSD-----QANDSMSEVDGEYSAGDQMEVDQOGEN	3235
OSTRICH	KMDPMNIWDDIITNRCFFLDKIQEKLPRD-----QANDSMSEVDEKDDIGDQMEADQOGED	3205
GECKO	KMDPMNIWDDIITNRCFFLNKIQERLPNT-----HLEDSEMEVDGGGDANDNIEGGNEKED	3245
TURTLE	KMDPMNIWDDIITNRCFFLGKIQEKLPI-----QADDSMEVDGRGDVGDKMETDMQEED	3244
ALLIGATOR	KMDPMNIWDDIITNRCFFLDKIQEKLLNV-----QADDSMEVVEAGDIGDEMEVDQOQEDN	3202
PLATYPUS	KMDPMNIWDDIITNRCFFLSKIQEKLGL-----QADDSMEMDGGGDTTDRMELEKQEDD	3234
TASDEVIL	KMDPMNIWDDIITNRCFFLNKIQEKLNCL-----QLDDSMSEVEGDGHFIDKVEVEKQEED	3238
HUMAN	KMDPMNIWDDIITNRCFFLSKIEEKLTP-----PEDNSMNVDDQDGDPSDRMEVQEQEED	3226
MOUSE	VTDPMHIWDDIITNRCFFLSKIEERLTAP-----SGDHSMSVDEDEESIDR-EVYEPKED	3226
CRASSO2	LLDTEAVWDDNVVTNRMVFLDHSNRLSTSLVK--KEEDAMEEDE-----	3198
POMACEA	QLDLVDIWDVVTNRNVYMDKIRDQMLSSNLM--EE-----DHD-----	3207
TRICHOPLAX	VIDPINVWDDVIVNRCMYLRKILLQYRVIQTAFTSTEDSMSEIDGEDRVIY-----TFPA	3219
NEMATOSTELLA	KLHPISVWDDVITNRRIFGLTVC-----VYRPDSMDVDGGEWS-CP-----SVDA	3210
PRIAPULA	TLDPVSIWDDTVINRCLYMDHLRHFHGNQPA-G-----	3246
SOFTCORAL	KLHSGVWEDVMTNRSVFLDKILLKFGQSSQL-HSSEDSMEIDGLN-----TTQ	3237
PISTILLATA	ILHPIGVWDDIVTNRVLFMSKFLQKFEAMGAE-ERSGIC----L-----DD	3257
HEMICHOR	KRDSNTWDDVITNRFVYLRKLFQKSGDAMEG----D-----DG-----QA	3247
BELCHER	RMDPISVWDDIIANRCLYLDKLNDFEQMAAR-GVLD--TEVGG-----EP	3259
STRONG	KRDPISVWDDVTQYRCLYMDKLCNLLGDSGGG-GGGGDSMETED-----QK	3257
STARFISH	KKDPINIWDDVVSRLLYMDKLGSRFIRSESQ-QAGE-----EE-----TA	3272

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus “putative archaeon”

		End RYG70450.1	Start RYG70459.1 (Archaeon)
ARCHAEON	IS-----GMFLRSVAVAVAQGKLTAVKPLETANAVR-----	KGMRVMCYLCFTV	3678
MUDCRAB	IQKLMKDAKSSLHKSVIKTALMNKNYHLANRHLLKCLRPLCGD----	DEELA-KFYFLMTE	3230
SCORPION	SEKFLKEQRLKMKLKFVEAALLQGNLQVAVKHLKWSQQIAKE-LKADH-HWINCIHLYCK		3276
SPONGE	VDSMMKNENINMFMRAADAARTQSNYPVAENYLNKIVEKSILKDFPDNYFIQLRWLHSLIK		3300
CAPITELLA	-IDPFGKQRVVMSLAQVDAASLQGNHVSARKLLKSADLVKV--VDSEELSVLFTHSHAN		3249
DANIO	LGVLVKTCFNMKLMQADSARKQNNFPVASKLLKELHRHA----	KIDDARLLRWVHSFSR	3281
MILII	INMAIRSCKFNMKLMKMAESGTKQNNFAVAMKLLKELHKES----	KARDDWAVKWTHTYSR	3301
BAMBOO	ITMLIRSCKFNMKLMKLESARKQNNFSVSTKLLKELHKES----	NIRIDWRVRWISYSR	3291
XENOPUS	IAVMINKCRFTMKMKMVDASARKQNNFSVAMKLLKDLHRES----	KTNEEDWSVKWIHSYSR	3304
STERLET	VGSMIRGCKFMSKLMADSARKQNNFSVATKLLKELHRES----	KNQEDWLVWRVHSFSR	3305
GAR	PDFLIKDCIKSMRLKMAESARKQNNFSVAKLLKALHKEC----	KARSHWNLRWAHGFCR	3302
LATIMERIA	ISAMVQSCFNMKLMKMAESARKQNNFSVATKLLKELHRES----	KSREECLTRVWHSYSR	3299
CAECIL	ITSMIKSCKFNMKLMKVESARKQNNFSVAMKLLKDLHRES----	KTRDDWSVRWIHSYCH	3302
SNAKE	THTMIKNCKFAMKMKMIECARKQNSFVALKLLKDLHGDS----	KTCEWDRVKWNHSYCC	3286
CANARY	IHSMIKSCKFNMKMKMIESARKQNSFAVAKLLKDLRKEA----	RWREDWLVWRWNYAYCR	3291
OSTRICH	ISSMIRSCKFNMKMKMIESARKQNSFVAKLLKYLHREA----	KTREDWLVWRWNYAYCR	3261
GECKO	IHSMIRNCKFMSKMKMIESARKQNSFVAIKLLKDLHRDS----	KTREDWLVWRWNHSYCR	3301
TURTLE	IHSMIRSCKFNMKMKMIESARKQNSFVAMKLLKDLHRES----	KTREDWLLRWNHYSYCR	3300
ALLIGATOR	IHSMIRSCKFNLKMKMIESARKQNSFAVAKLLKDLKRES----	KTRDSWLVRWNHSYCH	3258
PLATYPUS	IYSMIESCKFMSKMKMIESARSONNFRVAMKLLKDLHRES----	KTDDWLVWRWNHNYCR	3290
TASDEVIL	IYSMIRSCKFMSKMKMIESARKQNNFSVAMKLLKDLHRES----	KTREDWLVKWNHSYCR	3294
HUMAN	ISSLIRSCKFMSKMKMIDSARKQNNFSLAMKLLKELHKES----	KTRDDWLVSWVQSYCR	3282
MOUSE	VRCMLQSCRFTMKMKMIESAWKQSNFSLSMKLLKEMHKES----	KTREIWRVQWLHSYSQ	3282
CRASSO2	-EDLFLASKIHLRLKMDSSCHKRNHKLALNLIADIHKNYRD--KENEILNLEWSHLYAK		3255
POMACEA	-SSIFEDIKLRQQLKLAHSCQEQNNFNLTLRILKETYKCKR--EKSELLVVEWSHLYAT		3264
TRICHOPLAX	LKKRIAEEVSLYLKLDARTARLQSNYPVAIKHLRQTLYHINQELDKDELLTVKWTHTIYTK		3279
NEMATOSTELLA	LRERITREEVALQKMQAAREQSNFPVAHRYLRESLSKIED-----	NLHVKWTHTAYAV	3264
PRIAPULA	-SDPFLEQKFNLFQVQSAMQQRNPQVALKHLRTTNQLLK--KLDSDSLAVQWTHSYVR		3303
SOFTCORAL	LEEIFLRERVLFSLRLSEVATGQVNFVAKKQLQSSHLIRDRKNDSELEVLWTHSYGD		3297
PISTILLATA	IKDKFFKQEVLEKLCMANAAKEQGNVAVAHRCLEALYKI---	PQGNENLNISWSHTYAE	3314
HEMICHOR	MVNAISKDKLLMELKLVDSVSQNNFVGAEKYLRKNCADA----	RDDAWRLIWTLSYAR	3303
BELCHER	FSHRAQREQFLRLVLADSAREQANFPVALKHLKNTLKDF----	TEDDPLRLRWTHCYAR	3315
STRONG	FDDLVRREKVLMSKMDASACQANFCVAAKHLKSTHRGL----	VEFEDLRPAWTHSYVS	3313
STARFISH	LEKRILRERLWLELKMADSACQGNFVAQKHLKATHGSL----	SAHEDLKPWTHSYVQ	3328

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70459.1
ARCHAEON	SGRRAGLTIEEVQVVTFYNRASILEQVEFNKVEEL ^L TKTKKMLDMKDDSLR----KAQAE	3734
MUDCRAB	TNIQRGRS-----R-PQNRLQYLVEAWVKFLGKVTS-----MPVLEQ	3266
SCORPION	IDLKAKN-----QNYPEQLDTLL-CAHKQLAKLDL-----HFPKK	3311
SPONGE	VRLDRIHQ-----DPSPTDMEAVI-SLTCQMDNFKGRLGGSGKGAIS-	3341
CAPITELLA	ANKRKCAS-----GSEPSERLNLLV-EVKKRLDKCSE-----SSTLKL	3286
DANIO	FTHKRIAR-----LGPSEKINALL-KTVPLLK-DAE-----RQSEAL	3316
MILII	LSHRRSQR-----QARPEQVVTVL-KSIPLLV-EIN-----VDYLNNT	3336
BAMBOO	FSHKRSRS-----MKRAEQIVTVM-KTIPLLG-EID-----VGNLNI	3326
XENOPUS	YSHRSRSD-----LTCSEQILTAL-KTIPLLE-ESK-----TEYLTK	3339
STERLET	FSHTRSHT-----QSSSEQILTVL-KTIPLLE-ERK-----IDYTKA	3340
GAR	FKHLYSQA-----QSAEQILNVL-KTVDVLE-DSK-----TDPEKE	3337
LATIMERIA	FGHSRSQS-----QSCPERIQVTM-KTISLLE-ESK-----ADYLNK	3334
CAECIL	YTHRSRSQS-----QTSPDQVLSVI-KTVSLLLE-ETK-----ADYLRE	3337
SNAKE	FSHSRSRS-----QNAEQILTVL-KTVFLLD-EIK-----LSSVSN	3321
CANARY	FTHSSRN-----LSCPPEVLSVL-KTISLLE-DTK-----SDYLSK	3326
ONSTRICH	FTHSCSRN-----QSCPERVCSVL-KTISLLE-DTK-----SDYLSK	3296
GECKO	FSHSRSRS-----QSNPEQILTVL-KTVSLLD-EAS-----SGTLSK	3336
TURTLE	FSHSRSQS-----QNSPEQMLTVL-KTISLLD-ESK-----SDYLSK	3335
ALLIGATOR	VSHSSCQT-----QSSPQILTVL-KTVSLLD-ENV-----PDHLSK	3293
PLATYPUS	CSHSRSQS-----QSSPEKILTVL-KTVSLL-DDNL-----SSYLSK	3325
TASDEVIL	FSHSRCQI-----QSSSEQILTVL-KTVSLLADENL-----SSYQSR	3330
HUMAN	LSHCRSRS-----QGCSEQVLTVL-KTVSLLDENNV-----SSYLSK	3318
MOUSE	LNHCRSHT-----QSPREQVLTNL-KTITLLDESDI-----SNYLNK	3318
CRASSO2	THQLSAMSA-----DTDWTNDIFSSVI-TTIDRLGKFKD-----SSLFER	3294
POMACEA	THQKALSC-----SGIWSKDMLYNVL-STLDPLSKVAE-----SKMLRE	3303
TRICHOPLAX	VHCDKSL-----TPPDERLKTLL-TANSQFEKVKD-----LSVILE	3315
NEMATOSTELLA	TQQKAHG-----LMAIDAVQTAL-STVSKLGKP-S-----INTLAN	3299
PRIAPULA	TWQQIATGH-----Q-RDSADRLHRLD-DTIKELDKHAG-----KAVLHQ	3341
SOFTCORAL	LNCKKCPN-----LLPSEAVDTAI-SALDQLDKIKD-----SKVLQE	3333
PISTILLATA	VHFRKIQT-----LTAVGAVETAL-LVAGQLDKFSA-----SKILEI	3350
HEMICHOR	LHQKCLT-----LPPSKRVINLL-TTLDQLGMFTE-----G----C	3335
BELCHER	LHQKASL-----LTGADKLNVL-TTFEQDKFSS-----CRVFEE	3351
STRONG	MTQRKALL-----LKPYERITSLD-KALDHLGKLPV-----SHNLGS	3349
STARFISH	MNQKILT-----IELKEQVMTLL-TTFDPLAKLSN-----TPALTG	3364

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70459.1
ARCHAEON	NLVAFKNSKLGLEDIVQRIYGDLLVLAKDMSARYPNARSPETSVGAL--DKYTRSVMLI	3792
MUDCRAB	DATIETEYLKLE-----SSLCVEISEAMKDMGNSWQED-----DKYIKSL	3306
SCORPION	LDVSTMNHYLLQ-----SEIEMAADIVKYNDVH-----AEKIQEL	3347
SPONGE	SKPFISQHHVLL-----GKLLNKMAEIFATPEDGMLAL---SALSNDGNTKLNSLI	3389
CAPITELLA	NAALLCDQHLLQ-----GEHLVTMATILQNQVKDIDAL-----DQKLEKITES	3330
DANIO	SARMLRDQRILL-----GTTYDLMAGAADRSPFALETL-----GEEKVQKILQL	3360
MILII	HTRILRDQNTLL-----GSSYCILADALNKEPTCLQRI-----KEDQAERVIEH	3380
BAMBOO	QRHAFRDQNTLL-----GTTYIMANALNKDPSCLOYI-----EERAKNVKKL	3370
XENOPUS	NTKACRYQNMLL-----GDTYRIMADAVCKEPCLYKI-----EDGKAGKVKDL	3383
STERLET	TTRIVRDQNILL-----GTTYHIMANALTRDGLALEHI-----GEDKAGKVLDL	3384
GAR	TAQFRNQKLLL-----GTTYHIMASAVSRDPSVLEKI-----GPEKAGRVLKL	3381
LATIMERIA	NTRALRDQNILL-----GTTYNI IANALNKTPTSLODI-----GEEKARKIQDL	3378
CAECIL	NTREFRNQNLLL-----GTTYSI IANALCKDPRCLQRI-----DKNKADKVLQL	3381
SNAKE	NAITFRNQNLLL-----GTFHIMANALSKERSCLNQI-----GEEKARKVFML	3365
CANARY	NIMAFRNQNLLL-----GTTYQIMANALSQDPRCLEQI-----EKEKARKISLI	3370
OSTRICH	KVTAFRNQNLLL-----GTTYRIMADALSHDPRCLEQI-----EEEKARKVSVL	3340
GECKO	DRLAFRNQNLLL-----GTFHIMANALSKDPRCLEQI-----VEEKARKVVLV	3380
TURTLE	NIVAFRNQNLLL-----GTTYHILASALSKDPCLEKI-----EEEKARKVVML	3379
ALLIGATOR	NIEILRNQNLLL-----GTTYRIMAVALS KDPRCLVEL-----EEDKVRKVSML	3337
PLATYPUS	NIVASRNQKLLL-----GTTYRIMANALSKEPASLEQI-----ERNKARKVMEL	3369
TASDEVIL	NSLAFRNQNILL-----GITYNIIANALSNEPTCLAQI-----EESKAKKVLEL	3374
HUMAN	NILAFRDQNILL-----GTTYRI IANALSSEPACLA EI-----EEDKARRILEL	3362
MOUSE	NIQASCDQSILL-----GTTCRIMADALSREPACLSL-----EENKVNSILTL	3362
CRASSO2	EAGLGRRHVLL-----GQAFGLLVKGVQSENCFSSL-----SDKN-SEKIMGI	3337
POMACEA	KPALGMRHMILE-----SRTFDVAVTGLMSVGNLEEL-----GDKT-CEKLQOY	3346
TRICHOPLAX	NTTLMREHLLLR-----SRLLDMTSKILAESDASIL-----DLLNEKESLYQLA	3360
NEMATOSTELLA	DPVIALRHHILR-----SRCFDILTDAIAGAGRSTLATYKLI CLINQPVDKSYCPC	3350
PRIAPULA	QRGLARENLLLK-----GRSIEAVAREVLTRPASLHTLP-----A-AT-REKLSLV	3385
SOFTCORAL	NASTGIRHLLK-----SRNLDAITNVLSIPGTW--DSL-----EKEAKEKLHGLC	3377
PISTILLATA	EPLRGIQHILR-----SKTFDILCKAML DGGVVIATLE-----SQAKN-ALVKLC	3395
HEMICHOR	EPSYRKQHEILS-----GRSCHLVAQTIQEAGDDIFDVI-----HLKCRKS-----	3376
BELCHER	DLAVAKQHHTLT-----SLSYEIVAHALIQEGGAILTGL-----KDTRHAQLLTAA	3397
STRONG	DLFLLCDHRILT-----SKTYQSMASALQEEKGEMLTR-----SDAGKLDKLLSK	3395
STARFISH	DYCLTRHHHTLT-----SKSYDLVAIAIQKGGADILTGL-----RNVGKLDKLLGL	3410

Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70459.1
ARCHAEON	EETATIEDMQREAIIVSLREKSYTCLARHSLQMLAKYKA-----NELD-GAAGKDLVSV	3845
MUDCRAB	AEK-FPNAKDKSSWYKELLCSSYKSLKSAVNCGEEKFQMLNN--LYEGAHSHSKDIYMTL	3363
SCORPION	TDT-F-SIQSKSKLEIDLFCCKNYEYKCAIDIIQEVEQK-----MIEFDQATIGETYFKF	3400
SPONGE	GGT---PSTSTKAISEGLWIQALSSFNAGVRSGLTTLNP-----LTKDPVPTVQSLEEL	3439
CAPITELLA	VGS---PALSHQEIVASLHEAAYNSFKSGVGVAAASQPES-----VCVNKAYMSL	3376
DANIO	SQA---S--SIAQVVEGLQIQALELLRSAACKAEEEEQSFSSQ---QHVNTHGIVEAYMTM	3412
MILII	SGS---SSEEIQEVVIGLHRKTLHYLERAVRKAEEEVQSLAG---EHVDIAGVIEAYVNL	3434
BAMBOO	SGA---TSDNPVQVSIGLYRKAHEYLQSAVKKAEEEVQSLSE---EHVDTVGVIKAYMTL	3424
XENOPUS	S-----ESPENVVGGLYRKSLEYFTNAVRKATEEEQSHST---DQIDVRGIIKAYMTL	3433
STERLET	LGT---TSDNLEQVVVGLHRKALQHLQNAVKKAEELQSRST---EHIDIPGAIEAYMTL	3438
GAR	SGA---SSSNPQQVTAGFHKRALGLMQSAVKKVEDEVQSRSA---DHVDTAGAI EAHMTL	3435
LATIMERIA	SGA---QSDHPEQIVISLYRKALSYLQTAACKAEEQVQSRST---EHIDVAGVIEAYMTL	3432
CAECIL	SGT---MSENPDVAASLFKKSFHLYLDSAVKKAEEEVQSRAM---ENVDTTGVIKAYMTL	3435
SNAKE	SEE---RSDNVEKVIAGLNKRAFLCFSGAVKKAEEEVQSMSF---DHIDISGIIDAYMTL	3419
CANARY	SGE---SLENPKKVLAGLNKKAFCQFCFAVRKTEEEVQSSSV---DHVDMVGVVDAYLTL	3424
ONSTRICH	SGE---SLESPEKVLAGLNKRAFQCFSSAVRKEEEVQSHSM---EHVDVAGVIDSYMTL	3394
GECKO	SGE---KTDDIGKVIAGLNTRAFQCFSSAVRKAEEEIQSLSF---DHINTKSIIDAYMIL	3434
TURTLE	SGE---RPENSEKVIAGLNKKAFCQYFSTAVRKAEEEVQSHSM---EHVDLTGVIDAYMIL	3433
ALLIGATOR	SGE---KPDSPKVIASLNKQAFQYFSNAVRKAEEEMQSRM---EHVNLTGVIDAYLTL	3391
PLATYPUS	SGA---SFDNVQKVIAGLHRRAFQYLTHAVRKAEEEEEQSHSS---EHVDTGGVIDTYMTL	3423
TASDEVIL	SGA---SSEDAEMVIGGLHKKAFECFLKAARRAEDEVQSHST---EHVDIAGVIDAYMTL	3428
HUMAN	SGS---SSEDEKVIAGLYQRAFQHLSEAVQAEEEAQPPSW---SCGPAAGVIDAYMTL	3416
MOUSE	SGS---NAENTETVITGLYQRAFHHLSKAVQSAEEETQLSCW---GHEAAAERAHAYMTL	3416
CRASSO2	SKA---SKLNPRELARCLVEEGYNQMRKSLSYDGRG-----TRTCRYGLEEAYLAL	3385
POMACEA	TK----SPLNKGDLIKELIHHGYESLRKVI SEVPEDS-----SRDAVCLQODVQLAL	3394
TRICHOPLAX	NVN---QHDSKEKIAAKLTSHACQALHQAV-----KAS-----KEERGGSSYIEAMMM	3406
NEMATOSTELLA	NVC---LQ-----IVSQLITRSFTSLQEANKAAKQAATS-----SSDGSTTCMVEAMMM	3397
PRIAPULA	AGA---REHDHTALVSGLISAGFRELRVAVDVGDEEESSASL-----ASSPSAAHVAM	3435
SOFTCORAL	SSK---NPEQLDKILGHLTTKSFTTLQRAIKIAQTNENN-----QKNAESVRNLVTSSMTM	3430
PISTILLATA	RID---ETESQKKVSDLMTRS FVSLQSAIKAAKNAEGK-----CNTTQTSGLTVDAMIAM	3447
HEMICHOR	--L---RSLIEALIVNGLQNKAEHYFKKGVKLASDEEDA-----IDMDREGVIDAYVSM	3425
BELCHER	GVS---PDTSVDQTISSLLQKGHACLQKAVKLASDEEKA---RQDTSLDKSGIVDAFMAM	3451
STRONG	AEC---QESKPEKVCQSLFMKSKYLDDAVGTIKLDPASHSLSSAKREEQSMakahMAL	3452
STARFISH	VGQ---NATRPEQICSTLYSKAYSELKQAVSLADKDDA-----VTSQSERSMTEAYMAL	3461

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70459.1
ARCHAEON	TAR CQ QV L FDRAGVFAASN-----VAP E MLAHIVIESM I K G LSLQ S S F CM E R V L	3894
MUDCRAB	AKY C ED C LE K WKESID-----VSDYADSLVMS V LR A MSLGS R E A H F H F FP	3407
SCORPION	ANY C N K I L RMQEEEE E KTLS-----LS F ETYP S VL T NSL N AL K NG N L N AI K L F FP	3449
SPONGE	FG F CD N AL R QEDHDDEQ S T-----GLDT K S F PS I I N H T L T AM S LG S SK A RE L FP	3489
CAPITELLA	V H F C DQ V L R QRENDEI S GT-----K C E S EED F PLAL V T S LS L AM K NS S K D AR Q L F FP	3427
DANIO	AN F CD R RL R ESE Q K E EAI-----SS K L Q SL P EH V V K MM L K A L K LS S E E AR L K F FP	3461
MILII	AN F CD R CL R E K EES A TAIN-----F S E Q Q T FPAC V VE K IL K AM K Y N S K E A R L K F FP	3484
BAMBOO	AN F CD R CL R EEEE E SEN I NN-----F P EL Q T Y PAS V VEN M L K AL Q Y N S R E A R L R F FP	3474
XENOPUS	V D F C D S HL R K V EEEE S AV M D-----R A D Y Q N FP E IM V E K M I K A L K L N S S E A R L K F FP	3483
STERLET	V N F C D K RL R EEEE S AE V ST-----F S EL P TF P AV V VD T M L K A L K L N S S E A R L K F FP	3488
GAR	AN F CD K RL R EEEE E NDQ V SE-----F S EL P TF P AI V VE Q V L K A L K L N S S E A R L K F FP	3485
LATIMERIA	V D F C D K RL R EV E ESAE V SH-----F S EL Q TF P AV V EN L L R AL K L N S R E A R L K F FP	3482
CAECIL	V D F C D T HL L K K ED T T A VID-----H S HL Q Q F PT I V V E K M I K S L K L N SK D AR L K F FP	3485
SNAKE	AN F CD S HL R K E E Q NS A DV N -----N E D L Q I FP A IV V E K V I K A L K L N S N E A R L K F FP	3469
CANARY	I S F C D Q Y L R R EE E GL E IN-----T V DL Q FP A IV V E K M I K A L K L N S R E A R L R F FP	3474
OSTRICH	V G F C D Q HL R EE E GL L EIN-----T A DL Q L F PA I V V E K M I K A L K L N S R E A R L R F FP	3444
GECKO	AN F CD T HL R K K EE G S A DIN-----A V DL Q M F PA I V V E K V I K A L K L D S K E A R L K F FP	3484
TURTLE	V D F C D K HL R K E EE G SS D V S -----A L DL Q TF P AI V VE K M I K A L K L N S R D A R L K F FP	3483
ALLIGATOR	V D F C D K HL H K E RE G LS D IS-----A V DL Q TF P T I V V E K M I K A L K L N S R E A R L K F FP	3441
PLATYPUS	V D F C D K HL R NE E EG T S V ID-----A V VL Q AY P AL V VE K M M K A L K L N S R E A R L K F FP	3473
TASDEVIL	V D F C D R HL R K E EE S T S VIH-----T V EL Q T Y PAL V VD K M L K A L K L N S K E A R L K F FP	3478
HUMAN	AD F C D Q Q L R K EE E N A S V ID-----S A EL Q AY P AL V VE K M L K A L K L N S N E A R L K F FP	3466
MOUSE	V G F C D Q Q L R K VE E S A S Q KT-----S A EM E AY P AL V VE K M L R A L K L N S S E A R L K F FP	3466
CRASSO2	A Q Y C N K F L R M AED D T D K E SL N LS-----K E C Q K N FP E T I T V CL L N A M K L D S M E A R Q R F FP	3439
POMACEA	AKY C D K Y L R L AE E ND G L----VA-----S E S M E V FP A T A V K CL D AM R AG S AE A L E R F FP	3444
TRICHOPLAX	V N F C D D IL R HE E D G RAN Q ----PK G L---ID T K I F P E V I I R Y T L E A M A Y N S M D A R Q R F FP	3458
NEMATOSTELLA	V P F C D R AL R R K E D ES D GPS F I I SP F GL H Y E F V F Q R F PE F V V RY V L K AM E H G S E E A R N R F FP	3457
PRIAPULA	AS Y CD Y F L R V RE D D G T T V-----L P TD G Y A ET V I T SL L R A M A L G S S E A R D S F FP	3483
SOFTCORAL	AN F CD R L L R M K E ED S E Q TP-----R L DM K L F PG I V I R F V L K S M A F E S A E A R Q K F FP	3480
PISTILLATA	V N F C D N CL R K K EV S V A P V E-----V D TK L FP G I V RY M L K S M C Y S S K E A R Q K FP	3496
HEMICHOR	AT F CD K ML K Q Q E Q NE D G A V-----S R SS K SP S FP R SV V F H LL K AL K L N S V E A I Q R F FP	3477
BELCHER	V G F C D K IL R H Q ED D EE G T E -----L S S I P L AA A V V SN L L Q AL R H D S P E A R Q R F FP	3501
STRONG	V S F C D Q L L R Q Q D DD C NP D -----Y L PL M E A Y P ST V V N ST L Q A M N L N S P E A R Q H F FP	3503
STARFISH	V S F C D R ML R L K ES D EV P M T -----Y L P Q T D N F S Q T V V H Y T L K A M H Y S S Q E A R Q R F F	3512
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus “putative archaeon”

		RYG70459.1
ARCHAEON	VLFNLI TEHTQHVSQVTFGRSRSGYLEQLLQI PAWCYLRFS AQLMGS LDLSCGDVVYPI	3954
MUDCRAB	RVINLMSDDSS-----LVATFKKEAKKV VVMFL LWISHILIIY VDKLSGEALQPI	3457
SCORPION	RLLQIIIEVYPD-----TIPEFIAKSKV VPCWML SWINQLLTL LDKPEATAVQYI	3499
SPONGE	RLLQLVEAHPD-----TMDLMINKSSTI PCWMI F I GWINQMIAL VDKPESRAVHDI	3539
CAPITELLA	RLLQIIERFPQ-----TREV FIRKSRDI PAWMFL GWVSQICAI LDKPESSAIHEI	3477
DANIO	RLLQLVEVYPAE-----TL DLMVREVVSV PCWLLI GWISQMMAL LDKPQATAVQHV	3512
MILII	RLLQIVKLYSAE-----TL DLMKKEVSSV PCWQFI GWINQMMAE LDKKEAVVQHI	3535
BAMBOO	RLLQIVELYPVE-----TQDVMTRGVSTI PCWQFI GWINQMMAE LDKKEACVIQPI	3525
XENOPUS	RMLQIIIEQYPSE-----TL DLMARENCTV PCWQFI GWISQMMAL LDKKESIAVQHI	3534
STERLET	RLLQIIELYPAE-----TL DLMKEVSSV PCWQLI GWISQMMAL LDKKEAVAVQHV	3539
GAR	RLLQIVELYSAE-----TL DLMIKEMSSV PCWQLI GWISQMMAL LDKKEAVAVQHV	3536
LATIMERIA	RLLQIVELYPAE-----TL DLMKMGSSV PCWQFI GWISQMMAL LDKKEAVAVQHI	3533
CAECIL	RLLQIVELYPAE-----TL DLMTREVSSV PCWQFI GWISQMMAL LDKKEAVAVQHI	3536
SNAKE	RLLQIVEKYPEK-----IL RLMQEISSV PCWQFI GWISQMMAL LDKNEAPAVQHT	3520
CANARY	RLLQIIERYPAE-----TL GLVTQELSSV PCWQFI GWISQMMAL LDKDEAVAVQHT	3525
OSTRICH	RLLQIIERYPAE-----TL GLVTRELSSV PCWQFI GWISQMMAL LDKDEAIAVQHT	3495
GECKO	RLLQIVEKYPTTE-----TL GLMQEISSV PCWQFI GWISQMMAL LDKKEALAVQYT	3535
TURTLE	RLLQIIERYPAE-----TL GLMQEISSV PCWQFI GWISQMMAL LDKKEAVAVQHT	3534
ALLIGATOR	RLLQIIERYPAE-----TL SLMQEI STV PCWQFI GWISQMMAL LDKDEAVAVHHT	3492
PLATYPUS	RLLQIIERYPEE-----TL DLMTQEISSI PCWQFI GWISQMMAL LDKKEAVAVQHT	3524
TASDEVIL	RLLQIIERYPEE-----TL NLMIKEMSSI PCWQFI GWISQMMAL LDKKEAVAVQHT	3529
HUMAN	RLLQIIERYPEE-----TL SLMTKEISSV PCWQFI SWISHMVAL LDKDQAVAVQHS	3517
MOUSE	RLLQIIIEQYSEE-----TL NIMTKEISSI PCWQFI GWISHMVAL LDKKEAIAVQHT	3517
CRASSO2	RLLQLVEMYPE-----IR STFVEKSGQV PCWMI F I MWISQMMAL LDKPEGSTVHHI	3489
POMACEA	RLLHIIIEHYPD-----TT DMFLKKSETI PSWMI F I LWISQMMAL LDKHQAHAVRPI	3494
TRICHOPLAX	RLLQIVERNPN-----TI DGMFKSSAI PSWMI F I GWISQMMAL LDKPEARAVQEI	3508
NEMATOSTELLA	RLLQIVELYPH-----TL DSFVKKVETV PCWMI F I GWINQMVAL MDKKEARAVHGI	3507
PRIAPULA	RLLQLVDLYPD-----TL PLLTSKVESV PCWMI F I GWISQMMAL LDKREARAVQGI	3533
SOFTCORAL	RLLQLVELYPGG-----DI EAFKRKSSDV PCWMI F I GWISQMMAL LDKRESHAVQGI	3531
PISTILLATA	RLLQIVHKYPD-----TL EAFVKKAADV PCWMI F I GWINQMMAI LDKPEGKAVHGI	3546
HEMICHOR	RLLQIVETYTD-----TMDTFVELTSET PCWMI F I GWIGQMLAL LDKVESISVQGI	3527
BELCHER	RLLQLVEIYPD-----TMDLFIEKVSHV PSWLCI SWLGQMMAL LDKPEAVAVHGI	3551
STRONG	RLLQLVEKYPD-----TM QSLVKKASII PSWMI F I GWISQMMAL LDKPESLAVQGI	3553
STARFISH	RLLQLVEACPD-----TM QLMIKEVSDV PCWMI F I GWISQMMAL LDKPEGPAVHGI	3562
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus “putative archaeon”

		RYG70459.1
ARCHAEON	LLACSHPELRFSDAVKSIDSLAKNTN-TNLTSAVKQQVLNLLDEVYTFCLSQ-----	4057
MUDCRAB	MSLIVVPENTLKKSFKKILLIK-----NKEDIEVALNNLVADHLKVNNRSTRG	3561
SCORPION	LDLSVPELLYKYEYFKEILQMKKD-----KGDKNEIVKLYKKLHELFNYNPRDKMK	3608
SPONGE	LEQLNSPELAWKDWDYNELKPLVGS---VTVPKRDKNAIKRVWEQMSQLLETRSGLGDK	3650
CAPITELLA	LEMMHEPAVI IKDWIMDMKNAKGGG---SSQSLSMAYVKERYQELYKELLCESEDGSL	3591
DANIO	LQQLSNPEMLFKDWWDEVKNQLDKP-----NLDKMKMLQY--MTELLGDA-----	3613
MILII	LEQLSNPDMLFKDWDNFRSKLEKK-----E-NKTQLKNLYSEMYSNLANA-----	3637
BAMBOO	LEQFSNPDLLFKDWDANFKTELEKK-----VKDKKLLKNMYDEMYSNLASL-----	3628
XENOPUS	LEQLSNPPMIFQDWWEDVSNELSKP-----NVNKNKIKELYKEMYTNLGNP-----	3637
STERLET	LQQLTNPEMLFKDWWEDVKKELEKP-----KTDKKLLKNMYEEMYSALGNP-----	3642
GAR	LQQLSNPEMLFKDWDLEDARNTLSKP-----KTDKKDAKKMYEEIISVLGNA-----	3639
LATIMERIA	LEQLTNSDMIFKDWVDDVDRNELDKP-----QRNKANLKRMYEEMYANLGNL-----	3636
CAECIL	LEQLSNPDMIFKDWIEDMKNELAKS-----QRNKNNIKKLYEEMYMNLGNL-----	3639
SNAKE	LEQLSNPAMLFKDWIGDVQNELGKT-----KKNTNNIQQLYDGMYYQNLGNL-----	3623
CANARY	LEQLSNPVMIFKDWAEEDVDRNELSKP-----QRNKKKLKEMYERMYKNLGNL-----	3628
OSTRICH	LEQLSNPMMLFKDWTEDVDRNELVKT-----QRNKNKLQDMYERMYRNLGNL-----	3598
GECKO	LEQLSNPVMLFKDWTDDMKNELGKT-----KRNKENILKLYDGMYYQNLGNV-----	3638
TURTLE	LEQLSNPVMLFKDWWEDVKNELGKT-----QRNKNNLKEMYEGMYRNLGDL-----	3637
ALLIGATOR	LEQLSNPEMLFKDWDVAVRNELGKA-----QKNKAKLKEMYEGMYGNLGNL-----	3595
PLATYPUS	LEQLSNPEMLFKDWDVEDIKIELTKT-----PINKNNLKRMYEGMYKTLGNL-----	3627
TASDEVIL	LEQLSNPELLFKDWDVDDVRGILMQT-----PVNKKKLEKMYEEMYAILGTL-----	3632
HUMAN	LDQLSNPELLFKDWSNDVRAELAKT-----PVNKKNIEKMYERMYAALGDP-----	3620
MOUSE	LDQLSNPDLLFKDWSDTKDELGKN-----PVNKKNIEKLYERMYAALGDL-----	3620
CRASSO2	LEHMSQPDIQFKDWFDDTRLKFMKN-----KPDKKAMKEEYQIMYKKVLEFTETVGRG	3597
POMACEA	LEQFSQPVMFQDWSRDITKILE-K-----RP-AAEIKKKYKEIYDMLLEMPHKGEQS	3604
TRICHOPLAX	LEQLSQPDLVFKDWWDEVKGL---K-----KKSGSIAESIRICYQKLRDGLLDVNASN	3613
NEMATOSTELLA	LEQLHNPMAFKDWCDEIKQLLQT-----KNKKAIKEAFRSIYKQLFDSSVNRATD	3615
PRIAPULA	LEQLSSPHMLFSDVADARPLLMTR-----RADFPARFRKIYASLFDTTTRSQEE	3643
SOFTCORAL	LEQLTNPEMVFKDWMDEVKVLLS-----TKGNAVKIRESYGEMSKKLLNVKKR----	3635
PISTILLATA	LEMLTNPEMVFRDWCEGPMKQLLED----QIKRNDSSQAVKQCFGAMFQLLMDCRKRRTKS-	3657
HEMICHOR	LEQLTNPEHICKDFTDDVLPALRAR-----NPTAVKKAVEGLYTRVFDSCRQSSQD	3636
BELCHER	LEQLSHPDQLFKDWDGDDADLKRLLKVDPKKRTKEDKVTIKRLYDEMYDSSLDFRSASQDS	3669
STRONG	LQRLTHPGFIFKDWISVIN-SKM-----NSKERDHPAIKQEQQLYQQLFES-----	3656
STARFISH	LEQLNNPEFVFKDWDADDVMKPLL-----NVAKRDKNKIRQACHEIYMNLINHRSTVTD	3673

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70459.1
ARCHAEON	-----SWPRIGHKIGKYNRHFAKALLPKVN---SIVGSKRESIFNKDVLGKLKE	4103
MUDCRAB	MAG-----EKGEVFCKVGLKLDVNVVALTK-----EFGGKMEEFKRMPV-EEIKK	3605
SCORPION	-----ERKLHLKVAKVCGSVVF---SEFGKDGNKLIISMP-KEASV	3645
SPONGE	---SLY-----GGSPSLQKGARQKTFAQAYAKNIE---DKFGKGGAKIISMSG-TQLAS	3697
CAPITELLA	-----YSDSADCSMGPYRSDVFKQFISQFD---EYFGKMGSKIPGLTF-MKVLS	3636
DANIO	-----KSPRFGSYRRKFIQKFSKEVE---KLLGAGGSKLYERRKDKDFLQ	3655
MILII	-----GAPGIGAFRRRFVTFGFKKID---QHFVKDGLLLNLMN-LKAFNV	3678
BAMBOO	-----QFPGIGAFRTRYVQVFKKAFD---QYFGKEGSRLLDMN-IKIFDE	3669
XENOPUS	-----KDHFMGAFRRRFCEKYTKDFD---KAFGPEGSKLLNIK-CDGFNK	3678
STERLET	-----RCQGIGAFRKKFAQHFSSKEFD---KTFGKGGAKLFDK-HDAFRK	3683
GAR	-----KAAGIGRFRKKFVETYAKRIEIVKELGKDGSKLWDKR-KD----	3679
LATIMERIA	-----RAPGLGSRFNSFVKAYGKEFE---RVYVKRGEKLLDMK-SSDFFK	3677
CAECIL	-----KAPGIGEFRRRFVQAHAKDLD---THFGKGGSKLVDMK-EDAFK	3680
SNAKE	-----EAPGLGWYRKQFIKEFGKELD---IHFVKGGSKLLGMN-ASVFIK	3664
CANARY	-----ESPGLGMMRKRFIQAFGKDLD---HHFGRGGSELLNMK-TSDFDA	3669
ONSTRICH	-----EAPGLGLLRRRFIQAFGKDFD---HQFVKRGSKLLNMK-ASDFDA	3639
GECKO	-----HASGLGLFRKRFIKEFGKDFD---SHFVKRGSKLLDMK-ASGFNT	3679
TURTLE	-----QAPGLGLFRKRFVQTFGKDFS---SHFVKGGSKLLDMK-ADDFNR	3678
ALLIGATOR	-----QASGLGLFRRRFIQAYGKEFD---TQFVKGGSKLLDMK-DNEFIK	3636
PLATYPUS	-----KAPGLGAFRRRFIQAFGNEFD---HHFVKGGSKLLQMK-LSDFTS	3668
TASDEVIL	-----EVPGIGAFRKKFIQTYGKEFD---RHFVKRGSKLLVMK-LSDFNN	3673
HUMAN	-----KAPGLGAFRRRFIQTFGKEFD---KHFGKGGSKLLRMK-LSDFND	3661
MOUSE	-----RAPGLGPFRRRFIQAFGKEFV---KSFVNGGSKLLTMK-VDDFCK	3661
CRASSO2	ASQ----RSQTEETLSMVDKGYPKKFAERFKKDVD---SCFGKNGEKLLDMSF-SKLAG	3649
POMACEA	GTQ-----AQQTSFGAVSMGEFHRRFVFAEVFKNEFD---NHFGVDGSKLVMTA-KEFSG	3654
TRICHOPLAX	ESE----AASSLTSGELIEFGSHKRRFIQHFQKVFIE---QYFGKDGSKLQSMKA-SDFEK	3665
NEMATOSTELLA	SSQ-----PAAEEMGPFRKKFSKEHASRFE---NIFVKDGEKLVNMSL-KTAK-	3659
PRIAPULA	-----PGGRGRYWSVFTRTWAREVE---EKCGRDGSKLLAMAA-ADANQ	3683
SOFTCORAL	-----GTNSDGLFEGSIRRKFAQEFSGNVV---KVCGEDGSKIIDMSI-KAFES	3680
PISTILLATA	-----GSQTRGTESGPFRTKFAQEFANEVQ---RIFVKEGEKLVGVKM-TDFSK	3702
HEMICHOR	---SLF-SESDAVTQSLPFGPFQKKFASDFVKPFQ---KRFVGERGCKILSMQHQKEFMN	3689
BELCHER	SMSLFGSQSSDLESQSVGFPGPFRRRFAQQFAKECE---KMFVKDGSRIIDMKE-KEFMK	3725
STRONG	GGR----QGGPSSSSQTVPEPGPYWKKFGREWQKRFD---SSFVKDGSKLAAMDY-KTWSK	3708
STARFISH	GAG----SSQDSQSSPSVGFNGFRRRFAQEWQKKFE---AAFVKDGTKVVIDMQL-KTFSE	3725

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70459.1
ARCHAEON	LRDATQNS-----MKHTSGRVSVAEFSEWLGDFDSTTL--HILIPSEQYTIVHA	4149
MUDCRAB	RLNSIRTVV-----NQRRENAPNQLKAYS PWLANFQASKHSDVLEIPGQYSGVSK	3656
SCORPION	KYETLLKKITTT-----MSEMKEAKLRDFS DWLSEFHSIKYSEDIEIPGQYTGKRK	3696
SPONGE	AFNEVYNKMRES-----LNKFSSSALLKDYS PWLDTFRQEDYLQVIEVPGLYDGRSK	3749
CAPITELLA	WLSDKSEKV-----KKAFSNKQPRK LKEYSQWLAEFQAGNHEASLEIPGQYTGEVC	3687
DANIO	QVDRMVQSM-----RGFQKEPGNMKEYS PWLSSFKAETLKNELEVPGQYDGSK	3704
MILII	AVGQIMET-----QKPEPPGNLKEYS PWSNFKPQFLGNELEIPGQYDGKCK	3725
BAMBOO	ATKKILETV-----CKKQQAPPGNLKEYS PWMSEFKPEYLRNDLEIPGQYDGKSK	3719
XENOPUS	TVGPLITKM-----KEQQKEPGNLKEYS PWMSEFKPEFLRNELEIPGQYSGRSK	3727
STERLET	ASDSLWGSISEE-----QKKEKEPGNLKEYS PWSNFKPEVLRNELEIPGQYDGKCK	3735
GAR	--EKFWQKLTTS-----IRSMDSIALPGNLKEYS SWLSNFRPETLRNELEVPGQYDGRSK	3732
LATIMERIA	VSDQLLTSM-----RKFQREPGNLKEYS PWSQFKPEFLRNELEIPGQYDGKSK	3726
CAECIL	TAYSLFNMM-----RGSQPEPGNLKEYS PWSNFKPEFLRHELEIPGQYNGRSK	3729
SNAKE	VANSLSEKM-----KKCEKEPGNLKECS PWMSEFKPEFLRTELEIPGQYDGKCK	3713
CANARY	IANSLHSM-----IKTHKEPGNLKECS PWMSEFKAEFLRSELEVPGQYDGKCK	3718
OSTRICH	ITSALLSKM-----TKSHKEPGNLKECS PWMSEFKAEFLRNEIEVPGQYDGKCK	3688
GECKO	IADSLLLKM-----KECHQEPGNLKECS PWMSEFKPEFLKHELEIPGQYDGKCK	3728
TURTLE	IAFSLLSKM-----KD-QKEPGNLKECS PWSDFKAEFMRNELEIPGQYDGKSK	3726
ALLIGATOR	IVNALLAKM-----RDGQKEPGNLKEYS PWLSEFKAEFWRNELEIPGQYDGKCK	3685
PLATYPUS	ITNSLNSKM-----KESSKPPGNLKECS PWLSDFRVEFLRSELEIPGQYDGKCK	3717
TASDEVIL	ITTTLLNKM-----REDSKPPGNLKECS PWSNFKVEFLRNELEVPGQYDGRGK	3722
HUMAN	ITNMLLLKM-----NKDSKPPGNLKECS PWSDFKVEFLRNELEIPGQYDGRGK	3710
MOUSE	ITGSLLVRM-----KKDSKLPGNLKEYS PWMSEFKAQFLKNELEIPGQYDGKSK	3710
CRASSO2	AYKKVYKDM-----DFEVKEKNLKPANLKDYCQWLANFNPSIQGKDEIPGQYDGKCK	3703
POMACEA	ILRNLO--A-----QFEKHKADLTPPTNIGKYCSWMANFNPNHESRELEIPGQYDGLRK	3706
TRICHOPLAX	IASRLIQEI-----SGKIKRPNLKEYC PWLSNFQAANFTYSIEVPGQYTGRSK	3715
NEMATOSTELLA	----L--K-----QQMVSPPGNLKEYS PWLTNFDQADSHAQLEVPGQYTGQSK	3702
PRIAPULA	VLSALG-----KEMK---TKAADSPGNLKEYS TWLTDFFHSSPATCQIEIPGQYRGRSK	3733
SOFTCORAL	AMKTTNEKM-----KAKKFVGNLKDYSPWLANFQTQSETIQLEIPGQYSGQSK	3728
PISTILLATA	WCRDIQQKMVKF-----RNRTPPPGNLKEYS PWLSRFQSNNFTHLEIPGQYKGGTK	3754
HEMICHOR	FRNEVDQLMR-----KKMSAPGNLREYS PWLSDFQPINYEKELEIPGQYKGRSK	3739
BELCHER	LKSGLQNMMDGFYRKAFPREKANCYAPGLLKDYCPWLSDFNPLDYDRELEIPGQYTGKVK	3785
STRONG	LRQDI-----CAKMT-----GKDDPGNLKEYS PWFTAFQTLR-GDELEIPGQYDGSK	3756
STARFISH	HYGKL-----YKEMAAK---RRDPPGNLKEYS TWFSDFQQLSYDRELEIPGQYGGKSK	3775

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70459.1
ARCHAEON	-TPREPEVINTIAGELLVME S IRK P KRLSLVSN T GVGYR FLVK G EDLR ND ERIE QLFGL	4208
MUDCRAB	PLPEYHVNISSFDENVMP Q SLRVPLR I VIRGSDEK D HKY LVK W GEDLR TD Q RM Q QVFTL	3716
SCORPION	PIPEHHVKICNFDQKVDIL S SLTK P RC L TIRGNDQK D YK FLVK S GEDLR Q D S R IEQLFDV	3756
SPONGE	PLPEYHAKITRFDAKVLIL S SLRK P KRLTIIGDDTREY M FLVK G EDLRL D Q R IEQLFET	3809
CAPITELLA	PLPEYHAKISSFDSQVTVLR S SLR M PK S IVIRGNDEKEY K FLVK G EDLR Q D Q RVQVFNL	3747
DANIO	PLPEYHAKITGFDERVKV M T S IR R PK R IIIRGDDERD Y PFLVK G EDLR Q D Q RIEQLFGV	3764
MILII	PLPEYHAKITGFDERVKV M S IR K PK R LIIRGNDEKEY P FLVK G EDLR Q D Q RIEQLFEV	3785
BAMBOO	PMPEYHAQITGFDERIKV M S IR K PK R LIIRGNDEKEY P FLVK G EDLR Q D Q RIEQLFDI	3779
XENOPUS	PMPEYHVKISGFDERVSV M A IR K PK R IIVRGNDERE Y PFLVK G EDLR Q D Q RIEQLFEI	3787
STERLET	PLPEYHARITGFDERIKV M S MR K PK R LIMRGNDERE Y PFLVK G EDLR Q D Q RIEQLFDV	3795
GAR	PLPEYHVKITGFDERVQ S LR S IR K PK R LIIRGSDERD Y PFLVK G EDLR Q D Q RIEQLFGV	3792
LATIMERIA	PMPEYHAKITGFDERIKV M A IR K PK R LIIQGNDERE H PFLVK G EDLR Q D Q RIEQLFEV	3786
CAECIL	PLPEYHVKISGFNERVKV M S IR K PK R IIILGNDEKEY P FLVK G EDLR Q D Q RIQQLFDV	3789
SNAKE	PLPEYHAKISGFDERIKV M Q SMR K PK R IIVIRGNDERE Y PFLVK G EDLR Q D Q RIEQLFEV	3773
CANARY	PLPEYHAKISGFDERISV M S LR K PK R IIVIRGNDERE Y PFLVK G EDLR Q D Q RIEQLFDV	3778
ONSTRICH	PLPEYHVRIISGFDERIKV M S MR K PK R ITIRGSDEQ E Y P FLVK G EDLR Q D Q RIEQLFDV	3748
GECKO	PLPEYHAKIAGFDERIKV M L SIR K PK R IIIRGSDERE Y PFLVK G EDLR Q D Q RIEQLFDV	3788
TURTLE	PLPEYHAKISGFDERIKV M S IR K PK R INIRGSDERE H PFLVK G EDLR Q D Q RIEELFDV	3786
ALLIGATOR	PLPEYHAKISGFDERIKV M S LR K PK R IIIRGSDERE Y PFLVK G EDLR Q D Q RIEQLFDV	3745
PLATYPUS	PLPEYHAKITGFDERVKV M A IR K PK R IIIRGHDERE Y PFLVK G EDLR Q D Q RIEQLLDI	3777
TASDEVIL	PLPEYHAKITGFDERVKV M A IR K PK R ITIRGNDEKEY P FLVK G EDLR Q D Q RIEQLFEV	3782
HUMAN	PLPEYHVRIAGFDERVTVMASLRRPKRIIIRGHDEREHPFLVKGEDLRQDQORVEQLFQV	3770
MOUSE	PLPEYHVRIISGFDERVKV M L SLR K PK R IIVIRGHDEKEY P FLVK G EDLR Q D Q RIEQIFEV	3770
CRASSO2	PMPEYHIKVVGF D Q R VKV M T S IR K PK R ITIRGNDERE Y H Y LVK G EDLR Q D Q RIEQLFFL	3763
POMACEA	PMPEYHVKVAGFDERVLV M S LR R PK R ITIRGNDEK D Y H LVK G EDLR Q D Q RIEQLFVL	3766
TRICHOPLAX	PLPEYHLKIASFGERLLV L K S IR K PLR L TVQGDDEKEY L FLVK G EDLRL D Q R IEQLFCV	3775
NEMATOSTELLA	PMPEYHVNIAGFDEKVLV L A SIR K PK R V T IRGDDERD H MFLVK G ED I RL D Q R IEQLFCM	3762
PRIAPULA	PMPEYHVKIAGFDEKVLV M K S LR L PK R ITIRGHDERE Y MFLVK G EDLR Q D Q RL E QLFDI	3793
SOFTCORAL	PLPEYHVKVAGFGEKV K A M S LR A PK R ITILGNDERE H TFLVK G EDLRL D Q R IQQLFGL	3788
PISTILLATA	PLPEYHVKIVGFDEKVQV L P SIR K PK C LIIRGDDEK D H M FLVK G EDLRL D Q R IEQLFGL	3814
HEMICHOR	PLPEYHVKIAGFDEKVKV M S LR K PK R L T IRGNDEKEY H NFLVK G EDLRL D Q R IEQLFGI	3799
BELCHER	PLMQYHAKIAGFDQ R VKV M S LR K PK R V T IRGDDERD H PFLVK G EDLR Q D Q RIQQLFDI	3845
STRONG	PLPAYHVKIAGFDE T VL T L S LR K PK C ITIRGNDE M D Y PFLVK G EDLR M D Q RIEQLFCI	3816
STARFISH	PLPEYHVKIAGFDEQVKV L S MR K PK R IIVIRGNDE H D Y SFLVK G EDLRL D Q R VEQLFRI	3835
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus “putative archaeon”

		RYG70459.1
ARCHAEON	MNQIVRKHERYSVEQDIVFNQALDFSQPVPYLLPEPATRPTLQADTGVKALEAL--RAR	4266
MUDCRAB	MNSVYSSSPLCA-----HTSFHPSLD	3737
SCORPION	MNDIYQCNAICF-----QNKL--KLE	3775
SPONGE	MNKVLSDDPICS-----QRRL--NLR	3828
CAPITELLA	MNEIYANDANCH-----ARRL--QLK	3766
DANIO	MNMILSQDTACS-----QRSL--ALR	3783
MILII	MNIILSRDAACS-----QRSL--QLK	3804
BAMBOO	MNIILSRDAACS-----QRNL--QLK	3798
XENOPUS	MNIILSQDAACS-----QRHM--QLK	3806
STERLET	MNIILSRDATCS-----QRNL--QLK	3814
GAR	MNIILSQDAACS-----QRNL--GLR	3811
LATIMERIA	MNIILSQDAACS-----QRNL--QLK	3805
CAECIL	MNIILSQDAACS-----QRNM--QIK	3808
SNAKE	MNNILSRDAACS-----QRNM--QIK	3792
CANARY	MNIILSQDATCS-----QRNM--QLK	3797
OSTRICH	MNIILSQDAACS-----QRNM--QLK	3767
GECKO	MNTVLLQDAACS-----QRSM--QLK	3807
TURTLE	MNIILSQDAACS-----QRNM--QIK	3805
ALLIGATOR	MNIILSQDASCS-----QRNM--QIK	3764
PLATYPUS	MNIILSQDAACS-----QRNM--QLK	3796
TASDEVIL	MNIILSQDAACS-----QRNM--QLK	3801
HUMAN	MNGILAQDSACS-----QRAL--QLR	3789
MOUSE	MNAILSQDAACS-----QRNM--QLR	3789
CRASSO2	MNQALESDPACK-----QRNL--KIK	3782
POMACEA	MNKVLEKDPVCK-----ARRL--VLK	3785
TRICHOPLAX	MNEILAQDSICS-----QQDL--RLR	3794
NEMATOSTELLA	MNEVMSEDPACS-----QRNL--RLR	3781
PRIAPULA	MNRSLDADAACR-----QRAL--RLR	3812
SOFTCORAL	MNDVMRDDAACH-----QRNL--SLK	3807
PISTILLATA	MNDIMANDSACS-----QRGL--RLR	3833
HEMICHOR	MNDILALDAACS-----QRSL--KLV	3818
BELCHER	MNDILTLDPACS-----QRQL--RIR	3864
STRONG	MNSILAQDAACS-----QRGL--TLT	3835
STARFISH	MNSILEQDSTCS-----QQGL--QLV	3854
	** :	

Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70459.1
ARCHAEON	TYGVVPMSTKVGILEWV PNTISLR AILAEEMVKDDYIQKTQRQAIEEKDGHLELSL FALS	4326
MUDCRAB	TYQVIPLSSEVGM LKW VESTQPLLD FIKDSFK EGEAKCLDEAE -----T---	3781
SCORPION	TYQVIPLTTKIGLIEW VDN TNVLGSFLK DAMTD KEKESFR -----ESD	3818
SPONGE	TYSVIPVTPRVGLIEW V RNTMPLKDFIQ LS DPEKKSLP -----A	3867
CAPITELLA	TFQVIPMTPRLGMIEW L KNSCTLKDFLR QGCSD VSWEQIQNKN -----LPNN	3813
DANIO	TYQVIPITSRIGLIEW MENT CTLKDFLSS RRTE EQEQKT -----ITR	3824
MILII	TYQVIPMTRSRLGLIEW LD NTCTLKDFLSS NITE ETQSR RQ-----QE	3846
BAMBOO	TYQVIPMTRSRLGLIEW LD NTCVVKDFL LSNMTE DEHKRPS -----P-	3839
XENOPUS	TYQVIPMTRIGLIEW LE NTCTLKEFL LN TMTEDEAKI YNSKT-----TNG	3852
STERLET	TYQVIPMTARIGLIEW LE NTCTLKEFL DRMTE EEERKH -----CKR	3855
GAR	TYQVIPMTRIGLIEW LE NTCTLKDFL DSR RTPEEKS -----SPS	3852
LATIMERIA	TYQVIPMTRIGLIEW LE NTCTLKEFLS NAMTE EEERTNYETLS -----PKKG	3852
CAECIL	TYQVIPMTRLGLIEW LE ATNTLKD FLYNSM S EA EQENC S--S-----T--	3850
SNAKE	TYQVIPMTRLGLIEW LE NTYTLKEFL LKNM S EQEK NCYN --S-----SQG	3836
CANARY	TYQVIPMTRLGLIKW LE NTCTLKEFL KNSM S EEED INYY --S-----PRG	3841
OSTRICH	TYQVIPMTRLGLIKW LE NTCTLKEFL KNSM S EEED FNYS --S-----KKG	3811
GECKO	TYQVIPMTRLGLIEW L NGTCTLKEFL LQ NM S EQEK ND YN --S-----SKG	3851
TURTLE	TYKVIPMTRLGLIEW LE NTCTLKN FL MES S EEK DD YH --S-----RKG	3849
ALLIGATOR	TYQVIPMTRLGLIEW L PNTCTLKN FL HS M S EE E K ADY C--S-----EKG	3808
PLATYPUS	TYQVIPMTRLGVIEW LE NTCTLKE L L KSM S EGE KAA YE--S-----NPKG	3841
TASDEVIL	TYHVIPMTRLGLIEW I ENTCTLKE L LL NM S EE E K AA YE--S-----GPKA	3846
HUMAN	TYSVVPMTRSRLGLIEW LE NTVTLKDLL NT S Q EE K AA YL--S-----D PRA	3834
MOUSE	TYRVVPMTRSRLGLIEW I ENTMTLKD LL S NM S Q EE K V ANN--S-----D PKA	3834
CRASSO2	TYQVIPMTRSRLGLIEW M NDTIPLKEFL IC N LTE Q E AK F V S-----	3822
POMACEA	TYQVIPMTRVGLIEW M SNTIPLKEFL L N AMTE K ERT AY F--G-----E-NG	3829
TRICHOPLAX	TYQVIPITQRLGLIEW M KNTITLKEF VTD AM ED HEK QH YL --S-----SQNS	3839
NEMATOSTELLA	TYQVIPMTQRVGLIEW L KNTKPLKE LL HIA ATE S E K Q AM V--V-----RRKT	3826
PRIAPULA	TYAVVPMSTRLLGLIEW V PRTKPLKQL L Q E AM T Q Q Y DAY Y --S-----YSMN	3857
SOFTCORAL	TYKVIPMTRSRLGLIEW LE NTTVLKEF IR N GL S ET EN ET FD --T-----I---	3849
PISTILLATA	TYQVIPMTPRVGLIEW M NNTKPLKGV L S AMT K A EN D H YI--G-----P-NG	3877
HEMICHOR	TYEVIPMTPRIGLIEW V DHCLPLKV FL S EAMT K N ERS SH YA --N-----T---	3860
BELCHER	TYGVIPMTRSRLGLIEW M QNTTPLAG FL E NAMT T RE Q E A FL--H-----Q-RL	3908
STRONG	TYQVVPMTPRLGILEW V KRTTTLKDFI TR S MTE A E H K V Y T --S-----RTTG	3880
STARFISH	TYEVIPMTPRLGMIEW A QNTTTLKEFL H L AMTE Q E G N AY N--S-----R-HG	3898
	*: *:*. .:*. : .:	

Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70459.1
ARCHAEON	SAELRTNWLK-----GNGTTDYHQMYRNAPLASAAAVYDAITSILPTYYLQRR	4375
MUDCRAB	FYRTEEPWNF-----RKKTTDKRRVKKYEDAVNRIPWDILRRGL	3820
SCORPION	PKMTFYKFLLSKTNS----RDKSIPLLYENIYKI-ADTEVNKKFTECINMIPWDLFRRAF	3873
SPONGE	ASKMNQKWLEQKFGG-----SNYVNWYEMYKKLKADEVKKEYRRIVSAVPWDLRRSL	3921
CAPITELLA	PANLLCQWIGDSSNT-----RQMIENYRKCYQKYSRNETLNAFKKREAMVPWDMRLKSY	3867
DANIO	PNEFYDEWISKVAG-----KVEGIRRYAELYKKAKRVDTVNNFRRIEQMVPDILLKRAF	3878
MILII	VLPKYREWLOKMagr----K-DMFLRYPTMYLKASRTETVTAFRTHEQAI PGDILLRAF	3900
BAMBOO	-KELFSEWLQRISSG-----KSDVTTLYGQMYMKASRTETVKAFRQCERAVPPDILLRAF	3893
XENOPUS	PLYHYNAWLDKKEK-----VGDARQHVTSYTRCDRTNTVASFREREALVPKDLLRRAF	3905
STERLET	PAESYMEWLSKVAG-----KEKGIAQYITMYKTAKRTETVRAFRNVEHHVPEDILLRAF	3909
GAR	PQDMYSAWLEKISR-----RSKGQEQYHEVYKKASRTETVANFQSI EKLVPQDILLRAF	3906
LATIMERIA	PKAQYNEWLTKMAGG-----SVGPQRYGSMYKRASRTETVMAFRSVESSLVSRDILLRAF	3906
CAECIL	-TKHYKDWIQKMG-----CDNISRYEYMYRRASYTETVVAFKARENLPDILLRAF	3902
SNAKE	PFADYKDWLCKMGE-----RNRIECYMTMFKRASRTETVMSFQHRENRPEDILLKRAF	3889
CANARY	PRATYSEWLSRMGG-----KAQGISRYHMYRNASRTETAVTSFKSRESSVPEDILLRAF	3895
OSTRICH	PRATYNEWLSKMGG-----KAQGVPRYHVMYRNANRTETVMSFKSRESSVPEDILLRAF	3865
GECKO	PRADYNEWLSKMGD-----RNAGLVNYVSMYKKASRIETVTSFQQRENLPEDILLRAF	3905
TURTLE	PRIMYSDWLSKMAGK-----ENGIARYKTMYSRANRTETVLSFRNRETSVPGDILLRAF	3903
ALLIGATOR	PLFAYNEWLSKMAGG-----KIEDFARYMPMYKRASRTETVMSFRNRENRPEDILLRAF	3863
PLATYPUS	PVHEYSEWLYKMSK-----KQDFGAYMLMYKHASRTETAVTAFRNRENRPDILLRAF	3894
TASDEVIL	PQLEYSTWLTKITG-----KQDISAYMLMYRRANRTETITTSFRNRESKVPADILLRAF	3899
HUMAN	PPCEYKDWLTKMSG-----KHDVGAYMLMYKGANRTETVTSFRKRESKVPADILLKRAF	3887
MOUSE	PIRDYKDWMKVSG-----KSDAGAYVLMYSRANRTETVVAFRRRESQVPPDILLKRAF	3887
CRASSO2	-GNLHNSWIMKLSKD-----PRDVQQGYMQMYLKYNMTETRRELQKKENIIPWDLRRAF	3876
POMACEA	PSQLHYKWLPKLPK-----TDWGLIYGQVYQNYSKTETMKEFRICESKVPWDLRRAL	3883
TRICHOPLAX	PHQLYSKWLKFGSA-----GGPVYMYQSMYRKAKRSEVENHFKFRENSVPWDLRRGF	3893
NEMATOSTELLA	KNMLDL-----TLRILFDIIISREANRTDTESEFKKKQAQVPWDLRRAF	3871
PRIAPULA	PVEHFNKWAATALTASESKRAASHVKLYARTFVQCSKSDTVRSFRERESMVPDILLRQAF	3917
SOFTCORAL	-GYKHNKWIVEKFPV---NGNKHIINNYYPFKKASREVI ERKFRELQNLMPHDALRRSF	3905
PISTILLATA	AGACYRNWIDKFKGD-----PRNPSRFYGEMFKKANRTETERSFTQKQALVPWDLRRAF	3932
HEMICHOR	-RLDHHTWVDKMKVHV---GDRTSHCVRYGELYKVASRTEILKKFQDLHTQVPWDALRRAF	3917
BELCHER	PLIDFDAYVHRLGGTV---K-NDPWGKVYGSLYQKASRTDVTLAFRQVQSKVTWDIMRRGY	3965
STRONG	PVALFTTWLQKFCQT---D-G-NITKLFTEAYKKANETETIKAFREREAKLPWDLRRGF	3935
STARFISH	PRYQHSEWVDKYAKG---N-QSNHGVRYGAVYRHANYTDTVKCFRSWEALVPWDLRRAF	3954

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70459.1
ARCHAEON	LSMSRNAETYYTLLHEFLASLSVNNIFGYILGIGDRHLENLLLDSSSTGSIVNIDFGICFG	4435
MUDCRAB	VRLSSSSEGFSSLRSLFANSYATMCVSHWLLGIGDRHCGNTLVSLKTGRVVGIDFGHHFE	3880
SCORPION	LKFSSSL EAFVILRYNFITSHAVLCISQWLLGIGDRHTGNFLVSTTTGIEVGIDFGHAFG	3933
SPONGE	ISLASTSESFLLLRCTFIQSLSVINICQYILGIGDRHLSNFMVDMETGQLVIGIDFGHAFH	3981
CAPITELLA	QKLASSPEASYFVLRGNCATSHALNCISAYIMGIGDRHLSNHMVDLINGKMI AIDFGHAFG	3927
DANIO	VRMSTTPEAFLSLRSHFSSSHAVLCISHWILGIGDRHLSNFMINTETGGMIGIDFGHAFG	3938
MILII	IKMSTTPEAFLLRSHFASSHALMCISHWILGIGDRHLSNFMV NLETGGMVIGIDFGHAFG	3960
BAMBOO	TKMSTTPEAFLLRSHFASSHALMCVSHWILGIGDRHLSNFMINLETGGMVIGIDFGHAFG	3953
XENOPUS	VKMSTTPEAFLSLRSHFARSHALLCVSHWIVGIGDRHLSNFMINMETGGMIGIDFGHAFG	3965
STERLET	MKMSTTPEAFLSLRSHFTCSHALMCVSHWILGIGDRHLSNFMINMETGGMVIGIDFGHAFG	3969
GAR	IQLSTTPESFLLRSHFASSTHALICVSHWILGIGDRHLSNFMVNMETGGMVIGIDFGHAFG	3966
LATIMERIA	TKMSTSP EAFLLRSHFASSHALMCISHWILGIGDRHLSNFMINMETGGMVIGIDFGHAFG	3966
CAECIL	TKMSTTPEAFLLRSHFASSHALICISHWILGIGDRHLSNFMINMETGGMVIGIDFGHAFG	3962
SNAKE	VKMSTTPEALLSLRSHFASSTHALLCISHWILGIGDRHLSNFMISTETGGLVIGIDFGYAFG	3949
CANARY	VKMSTSP EAFLLRSHFASSHALMCISHWILGIGDRHLSNFMINKETGGMVIGIDFGYAFG	3955
OSTRICH	VKMSTAPEAFLSLRSHFASSHALMCISHWILGIGDRHLSNFMINKETGGMVIGIDFGHAFG	3925
GECKO	VKMSTTPEAFLSLRSHFASSHALMCISHWILGIGDRHLSNFMVNMETGGMVIGIDFGHAFG	3965
TURTLE	VKMSTAPEAFLSLRSHFASSHALMCISHWILGIGDRHLSNFMINMETGGMVIGIDFGHAFG	3963
ALLIGATOR	VKMSTAPEAFLSLRSHFTSSHALICISHWILGIGDRHLSNFMINTETGGIIGIDFGYAFG	3923
PLATYPUS	VKMSTRPEAFLLRSHFARSHALLCVSHWILGIGDRHLSNFMINLETGGMVIGIDFGHAFG	3954
TASDEVIL	VKMSTTPEAFLLRSHFASSHALMCISHWILGIGDRHLSNFMINMETGGMIGIDFGHAFG	3959
HUMAN	VRMSTSP EAFLLRSHFASSHALICISHWILGIGDRHLNFMVAMETGGVIGIDFGHAFG	3947
MOUSE	VKMSTSP EAFLLRSHFASSHALLCVSHWLLGIGDRHLNFMVAMETGSVIGIDFGHAFG	3947
CRASSO2	HKMSTSP EAFHVL RCKCASTHALISICQYVLGIGDRHLSNFMINLKN GEMVIGIDFGHAFG	3936
POMACEA	QHLSSTPEAFHFLRCEMLTSHAVLCICHYLLGIGDRHLSNFMVNGRTGHMVIGIDFGHAFG	3943
TRICHOPLAX	VALSASSEAYLMLRSHFARTHATVSI CHYLLGIGDRHLSNFMIDRLTGGMIGIDFGHAFG	3953
NEMATOSTELLA	QQLAASPEAYLTLRTHFARTHACICICQYVLGIGDRHLSNFLVDMRTGGLIGIDFGHSFG	3931
PRIAPULA	LRLSASP EAFLLRTHFIKSHATLSVCHYVVGIGDRHLSNFMVSQEDGGMVIGIDFGHAFG	3977
SOFTCORAL	MRLASSPEAFLLRAYFARTYGCMTICHYILGIGDRHLSNSMVDLKQGRVIGIDFGHAFG	3965
PISTILLATA	LQLAVSPEAFFILRSHFASSHACLICQYILGIGDRHLSNFLVDMETGGMIGIDFGHAFG	3992
HEMICHOR	QRLSSSPEAFLLRSHFATSHALLCICQYILGIGDRHLSNFMISLDTGAMVIGIDFGHAFG	3977
BELCHER	LQMSSCP EAFLLRSHFTTTHATLCAQYVLGIGDRHLGNFMIDLES GGMVIGIDFGHAFG	4025
STRONG	MQLSASP EAFLLRAHFARSHAVLCICQYILGIGDRHLSNFLVSLLETGGMVIGIDFGHSFG	3995
STARFISH	IQLSASP EAFLLRSHFARSHAVICICQYILGIGDRHLSNFLISLKTGGMIGIDFGHAFG	4014
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70459.1
ARCHAEON	MGA--SVLPVPELIPMRLTRQLTDIAQPLQ--GLEVIRQHMQRVLGCLRKEKSLQLQNALE	4491
MUDCRAB	TAV--QVLPFPELMPFRLTRQIVNVFQPLG--PVGMIKDVMAVVLGTLQESRHVILSVLE	3936
SCORPION	TAT--QFLPIPELVPFRLTRQYLNLMPLK--EKGVIEATMISALSALRDNADILLNTMD	3989
SPONGE	SAT--QFLPLPELMPFRLTRQFVNLLLPHK--VSGQLRSCMIHTLRALRHSPTLLLNTMD	4037
CAPITELLA	SAT--QFLDIPELIPFRMTRQLRNLLLPLR--EKGVIEGTMVHSLRALRQHKEQLISTMD	3983
DANIO	SAT--QFLPVPELMPFRLTRQFINLMRPLA--ESGLIQSVMVHSLRAFRAEPDLLNTMD	3994
MILII	SAT--QFLPVPELMPFRLTRQILNLMPLMK--ESGLIRSIMVHGLRAFRLDPDLLSTMD	4016
BAMBOO	SAT--QFLPVPELMPFRLTRQFNLMLPMK--ESGLIYSTMVHGLRAFRLDPDLLNTMD	4009
XENOPUS	TAT--QFLPVPELMPFRLTRQIVNLMPLMK--DSGLFDSVMVHSLRAYRSDPGLLVTTMD	4021
STERLET	SAT--QFLPVPELMPFRLTRQFNLMLPMR--ESGQIYSVMVHSLRAYRADPDLINTMD	4025
GAR	SAT--QFLTVPPELMPFRFTQFNLMLPMG--VSGLISSVMHALRAYRAEPDLLNTMD	4022
LATIMERIA	SAT--QFLPVPELMPFRLTRQFNLMLPMK--EQGLIYSVMVHALRAYRANPDLNTMD	4022
CAECIL	SAT--QFLPVPELMPFRLTRQFVQLMLPMK--ESGLIESVMVHALRAYRTDPSSLITMD	4018
SNAKE	SAT--QFLQPELMPFRLTRQFVNLMPLMK--ESGLMYSVMVHSLRAYRINQDVLINTMD	4005
CANARY	AAT--QFLSVPELMPFRLTRQFVNLMMPVK--EWGLIYSVMVHALRAYRSDPDLISTMD	4011
OSTRICH	SAT--QFLPVPELMPFRLTRQFVNLMMPVK--EWGLIYSVMVHALRAYRADPDLISTMD	3981
GECKO	SAT--QFLPVPELMPFRLTRQFINLMPLMK--ETGLIYSVMVHSLKAYRVYPDLINTMD	4021
TURTLE	SAT--QFLQVPELMPFRLTRQFINLMPLMK--ESGLIYSVMVHSLRAYRTEPDLVSTMD	4019
ALLIGATOR	SAT--QMLPVPELMPFRLTRQFINLMPLMK--ESGLIYSIMTHALRAYRKDPDLINTMD	3979
PLATYPUS	SAT--QFLPVPELMPFRLTRQLINLMSPMK--ESGLVYSVMVHALHAFRTDPDLLNTMD	4010
TASDEVIL	SAT--QFLPVPELMPFRLTRQFINLMPLMK--ETGLIYSVMVHALRAFRLDPGLLISTMD	4015
HUMAN	SAT--QFLPVPELMPFRLTRQFINLMPLMK--ETGLMYSIMVHALRAF RSDPGLLTNTMD	4003
MOUSE	SAT--QFLPVPELMPFRLTRQFVSLMLPMK--ETGLMCTVMVHALRAF RSCAGLLTDTME	4003
CRASSO2	SAT--QFLPIPELIPFRLTRQLRNLMMPLO--VHGLMESTMIHTLRALRNNCDLLNTMD	3992
POMACEA	SAT--QFIPVPELMPFRLTRQIVNLGLPFK--VKGLENTMIHV LHALRQNHDLLSTMD	3999
TRICHOPLAX	SAT--QFLPLPELMPFRLTRQMLNLMPLR--ENGQLKCSMVHTLRALRNKPDLLVNTMD	4009
NEMATOSTELLA	SAT--QFLPVPELVPFRLTRQFTNLLLPLK--ESGLVRNTMIHV MRALRGNHELLNTMD	3987
PRIAPULA	HSHPRCCLPIPELMPVRLTRQFQLLLPHEGQRRGLYQTMVHTLRALRDNRHLLNTLD	4037
SOFTCORAL	SAT--QFLPLPELMPFRLTRQICNMMEPLR--VSGQLQSTMVYTMRALRNNHEILLNTMD	4021
PISTILLATA	SAT--QFQPLPELMPFRLTRQFVNLMPLK--KSGTLQSVMIHTLRALRSNHDLLNTMD	4048
HEMICHOR	SAV--ELLPVPELMPIRLTRQIVNLMTPMK--EDGLILSTMVHGLRALRNNPDLLNTMD	4033
BELCHER	SAT--QHLPVPELMPFRLTRQMLNLLLPLK--ESGLLQSTMVHVLRALRSSPNVLLINTMD	4081
STRONG	SAT--QFLPIPELIPFRVTRQIINLMPLMK--IDGVLQSTMVHTLRALRQNHELLVNTMD	4051
STARFISH	SAT--QFLPVPELMPFRLTRQIVNLMPLFK--KEGILQSSMVHTLRALRQNHELLINTMD	4070

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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70459.1
ARCHAEON	IYINDPLMDWMRGAAEALDREALDQREQLLGGSFESSGTLPP-----NNKEMSESVLW	4545
MUDCRAB	AFVKEPTEDWKEFVRELEG-----NLDESKIEM	3964
SCORPION	IFIKEPTVNWQENALKQKRIIGKVDEN-----VSDINIYPGNTESDDPNHSECDFNW	4042
SPONGE	VFIKEPSLEWESNAKKQALAQ-----KINTDDNTW	4067
CAPITELLA	VFIKEPSLDWQNAAKKEIQAMSNR-----KEDTSKLTLDLSQW	4020
DANIO	VFVKEPSLDWKNFELKQLKKGGTW-----TESVNTKEINW	4029
MILII	IFVKEPSLDWKNLELKQMKKGGTW-----NKDVNTREIHW	4051
BAMBOO	VFVKEPSLDWKNFELKQLKKEGSW-----SKDVNINEINW	4044
XENOPUS	VFIKEPSLDWKNLELKQMKKKGW-----KKAVDVTSHNW	4056
STERLET	VFVKEPSLDWKNFELKQMKKAGSW-----SEAVNTNEINW	4060
GAR	VFVKEPSLDWKNFELKQLKKGGTW-----KETVNTKEIDW	4057
LATIMERIA	VFVKEPSLDWKNFELKQLKKGGSW-----TKEVNTKEVNW	4057
CAECIL	VFVKEPCLDWNNFMLKQLKKGQGTW-----TKKVNTAEKNW	4053
SNAKE	IFVKEPSLDWKNFELKQLRKGGTW-----TKEINTDEVNW	4040
CANARY	VFVKEPSLDWKNFEQRQLKKGGTW-----IKEINTSEVNW	4046
OSTRICH	VFVKEPSLDWKNFEQRQLKKGGTW-----IQEINTSEVNW	4016
GECKO	IFVKEPSLDWKNFELKQLKKGGTW-----TKDINMDEVNW	4056
TURTLE	VFVKEPSLDWQNFELKQLKKGGTW-----SKEVNTAEINW	4054
ALLIGATOR	VFVKEPSLDWKNFELRLKKGGTW-----LKEVNTCEVNW	4014
PLATYPUS	VFVKEPSLDWKNFETKMLKRGGTW-----TRAVNTADTNW	4045
TASDEVIL	VFVKEPSLDWKNFEQKMLKKGGSW-----TREVNMTEMNW	4050
HUMAN	VFVKEPSFDWKNFEQKMLKKGGSW-----IQEINVAEKNW	4038
MOUSE	IFVKEPSFDWKSFEQTMLRKGGSW-----IQEINVTEKNW	4038
CRASSO2	IFVKEPSVDLWVNAEKQMNEMKVE-----VSPEDDEVQW	4025
POMACEA	VFVKEVSLDWLQFAERQMRGGMGP-----KDADEDMRW	4032
TRICHOPLAX	VFIKEPSLDWQNFANRQNAKQGL-----KTESDDFSW	4041
NEMATOSTELLA	VFVKEPSLDWQMFARKQAEDQHME-----IGMYEDLTW	4021
PRIAPULA	VFIKEPSIDWKATAERLADKDIHS-----NESDQGEQVQEW	4073
SOFTCORAL	VFVKEPSLDWQNFARKQAQKQLN-----LNDMTDLAW	4054
PISTILLATA	VFIQEPSLDWQVYARKQAKTQGIN-----EEEQKADW	4080
HEMICHOR	VFVKEPHLDWQKRAKSDASKYGDA-----AEDANEMIER	4067
BELCHER	VFIKEPHLDWKNFAAQMDKG-----MVGEDDDLDDISW	4115
STRONG	VFVKEPSLDWKCFAVKQADYQKLS-----EDSREDISW	4084
STARFISH	VFIKEPSLDWKTNASKQAKAQDAGR-----LEG-----QSDPDGNSLDESW	4113
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus "putative archaeon"

		RYG70459.1
ARCHAEON	EPVRRVGGALR KLS GEDPLALLQEDLSNNVMVTR--MKSVDGLCRILGDVRRLLGAEAG G	4603
MUDCRAB	FSEERMRCLKE KL TGFNPAYVTVWALSKNKAVRR-DPTAFEELKKV-----VL G	4012
SCORPION	YPKQRILFAKR KL EGINPCYITKEELRLGHSNKP----IFQRLTDV-----CL G	4087
SPONGE	YPKEKVNICR KL LGFNSSHMLIDLEHGFKNKP----EFKYLKGI-----LL G	4112
CAPITELLA	FPKEKVNIVRQ KL EGSNPSHVMRAELALGQLGS-----YLKYFVIV-----LM G	4064
DANIO	FPLQKVNFAARR KL EGTNPSVITSEELCLGF EKMP----EYKGLLAV-----ARG	4074
MILII	YPMQKVR YARR KL EGANPAAITRDELQLGHETTE----AYKSYVAV-----AM G	4096
BAMBOO	YPRQKVN YAKR KL EGANPSAITRDELQLGHEKSK----AYASYVAV-----AM G	4089
XENOPUS	HPQQKIHC AKR KL DGANPCETCEELRLGHESAP----EYKDFIAV-----ARG	4101
STERLET	YPMQKVNFAARR KL EGANPAVITSEELKLGFEKSP----AYQSI IAV-----A Q G	4105
GAR	YPRQKVQFAQR KL EGANPAAITSDLEKLGFEKES----WCRAALAM-----A Q G	4102
LATIMERIA	YPVQKVKCGRQ KL EGVNP I VITCNE LQLGHEKLS----AYQSYLAV-----V K G	4102
CAECIL	YAVQKVNCAARR KL AGTNPAITCDELELGHEKSV----AYKEMKAV-----AM G	4098
SNAKE	YPLQKVKIARR KL AGANPAVITCDE LRLGHEKSE----AFREYVSV-----A Q G	4085
CANARY	YPLQKVN YVRR KL TGANPAITCDE LRLGHESP----AYNDFAAV-----ARG	4091
OSTRICH	YPLQKVS YVRR KL TGNPGRITCDE LRLGHESP----FFSDFVAV-----ARG	4061
GECKO	YPLQKVNFAARR KL AGANPAVITSDLE LRLGHEKSS----AYRYVSV-----ARG	4101
TURTLE	YPLQKVNCAKR KL AGANPAVITCDE LRLGHESP----AYKEYVAV-----A Q G	4099
ALLIGATOR	YPLQKVN CVKR KL AGSNPAAITCEELRLGHEKSL----AYRDYVAV-----ARG	4059
PLATYPUS	YPLQKIS YAKR KL TGNPAITCDE LRLGHEKVP----AFGDYISV-----ARG	4090
TASDEVIL	YPLQKIN YAKR KL AGANPAAITCDE LHLGHEKVP----AFECYVSV-----A Q G	4095
HUMAN	YPRQKICYAKRKLAGANPAVITCDE LLLGHEKAP----AFRDYVAV-----ARG	4083
MOUSE	YPQHKIR YAKR KL AGANPAVITCDE LYLGHEASS----AFRSYTAV-----ARG	4083
CRASSO2	YPKEKIE YVKKR KL RGNPVCISREELKLGHSKKP----AFPALERV-----L Q G	4070
POMACEA	YPKQKIETAAR KL KGNPSYITRDEL RIGHLRNQ----ALKDFEKV-----AL G	4077
TRICHOPLAX	YPREKVTF AKR KL KGANPAFVTRDEL RRLCHHL-----SILESF-----AL G	4082
NEMATOSTELLA	YPREKVLTAQR KL KGANPAFVTRQEL ELGHRRS----WFRNLQSA-----CL G	4066
PRIAPULA	YPKQTI GVAR KL IGANPAHITKAELALGHRKHE----ALKQMTNV-----VL G	4118
SOFTCORAL	YPKEKINS AKR KL KGENPAEIMKQDLESGHKKAG----YYEMLSV-----LL G	4099
PISTILLATA	YPKQKVQSAWR KL EGFNPAYVMRDDLQLGHSKQS----WYQOMESV-----CL G	4125
HEMICHOR	YAKDRINNARR KL QGANPCHITRDEL KMNMIKK----HYCTGYIDV-----CM G	4113
BELCHER	YPREKIKFAAK KL QGVNPTHITKAELQLGHNLP----WFKSFCLV-----AM G	4160
STRONG	YPKKIKFAK KL QGVNSTYITKAEL EMGPHSKDARDAPFLKALKS-----TC G	4133
STARFISH	YPREKVNFAQ KL EGANPSDITQRELALGHSRNP----AFSAIKEV-----V K G	4158
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Supplementary Figure 9: Clustal Omega: DNA-PKcs alignment metazoan plus “putative archaeon”

		End RYG70459.1 (Archaeon)
ARCHAEON	TNAGRTGKMKAAVELTVEEQVDALMAMATDPNVLVRQWVGLQAWL	4648
MUDCRAB	QNCESARANMDRTGLTIHQQVDILLEQATDPNILGRTWVWGSPI	4057
SCORPION	DRK-SLRQNLPKNGLSVKQVQKSLIDQATDSGILSRIYFGWDPWF	4131
SPONGE	DSSTNLRARVGKRCDSVEDQVDCCLIDHATDSNVLGRTYGGWEAWV	4157
CAPITELLA	DKQADIRARLPADGLSSEEQVAALLNLATDPNILGRTFAGWEPWV	4109
DANIO	EEQHNIRARLADKDLTVEDQVDCLLDQATDPNILGRVWVGWEPWI	4119
MILII	DKEHNIRARVPEDGLSVEIQVDCCLIDQATDPNILGRVWVGWEPWM	4141
BAMBOO	DKDHNVRARESEEGLSVEECQVDCCLIDQATDPNILGRVWVGWEAWM	4134
XENOPUS	DKKHNRRTNEPPDGLTEETQVQCLIDQATDPNILGRVWVGWEPWI	4146
STERLET	EKEHNVRAREAPQGLSVEETQVECLIDQATDPNILGRVWVGWESWV	4150
GAR	EQGVNVRASQAAEGLAVEIQVECLLDQATDPNILGRVVMGWEPWI	4147
LATIMERIA	DPDHNVRAREVKEDLPVETQVACLIDQATDPNILGRVWVGWEPWM	4147
CAECIL	DKTHNVRAREPKDGLTEEQVKCLLDQATDPNILGRVWVGWEPWM	4143
SNAKE	SKQFNIRARQPQDGLAEIQVKCLIDQATDPNILGRTWVGWEPWM	4130
CANARY	NSNHDIRAKEPEDGLSEETQVRCLIDQATDPNILGRVWVGWEPWM	4136
OSTRICH	NAAHNTRAKEPEDGLSEETQVKCLIDQATDPNILGRAWVGWEPWM	4106
GECKO	SKEHNIRAKEAEDGLSEEQVKCLIDQATDSNILGRVWVGWEPWM	4146
TURTLE	SRDHNIRAKEPEDGLSEEQVRCLLDQATDPNLLGRVWVGWEPWM	4144
ALLIGATOR	TRDQNIRAKEPEDGLTEETQVKCLIDQATDPNILGRVWVGWESWM	4104
PLATYPUS	SKDHNVRARQPEEGLSEEQVQCLIDQATDPNILGRTWVGWEPWM	4135
TASDEVIL	NRDHNFRAQQPDDGLSEETQVKCLMDQATDPNVLGRTWVGWEPWM	4140
HUMAN	SKDHNIRAQEPESGLSEETQVKCLMDQATDPNILGRTWVGWEPWM	4128
MOUSE	NRDYNIRAQEPESGLSEETQVKCLVDQATDPNILGRTWVGWEPWM	4128
CRASSO2	DKRENVRAQLPASGLTVEEQVAALIDQATDPNIVGRVWVGWEPWM	4115
POMACEA	DVQDNIRARLKEKGLTEEQVAALIDQATDPNILGRAWVGWEPWL	4122
TRICHOPLAX	DKQYNERARMPADNLSVEDQVTCLIDQATDPNILGRTWQGWEPWM	4127
NEMATOSTELLA	DRRHNVRAQKEENELTSEAQVDCCLIDQATDVNILGRAWVGWEAWV	4111
PRIAPULA	DPRSDLRAQLPPEGLTVEEQVQCIEQATEPSLLGRTWVWVGWEPWM	4163
SOFTCORAL	DKQHNQRRARHYV--NTVENQVACLIDQATDPNILGRTYHGWEPWV	4142
PISTILLATA	DRNANVRAREPESGLSVEEQVSCCLIDQATDANILGRTWQGWEPWV	4170
HEMICHOR	DKKYSMRTREPATGLSVEKQVACLVDQAIDPNILGRAYEGWEAWV	4158
BELCHER	DGGKDVRQAQKPAEGLSVEDQVACLIDQATDPNILGRTWQGWQSFM	4205
STRONG	GNTESKRAQSKSKGLSVEDQVACLIDQATDPRILGKTYQGWEPWV	4178
STARFISH	DRSQNIRASSPKSGLSVEETQVECLIDQATDPNILGRVYAGWEAWM	4203
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