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ZmCCD8a	atgtctggcgccagcggcaggccgtcggccggtggctcggcggtaccgggccgtctgtccagcagcacacaggggggcaagggaaagcgggccgtggtgcagccgctcgcggctagc gtggtgacggagacgccagcgccggccgtagctccggctcggcccgtcgtcgacgccccgccgcgccgccgtgggggccgcggcaccgtcgagcacgcggcgtggaagagcgtccgg caggagaggtgggaggggcgctggagctggagggagagctgccgctctggctggatggcacctacctgaggaacgggccgggcctgtggaacctgggcgactacggcttccggcac ctgttcgacggctacgccacgctggtccgcgtgtcgttccgcgacgggcaggcggtgggcgcgcaccggcagatcgagtcggaggcgtacaaggcggcgcgcgcgcacggcaaggtg tgctaccgcgagttctcggaggtgcccaaggcggaggggttcctctcccacgtgggccagctcgccaccctcttctcgggctcctcgctcaccgacaactccaacacgggcgtcgtc aggctcggcgacggccgcgtcctctgcctgacagagaccatcaagggctccatcgtggtcgacccggacacgctcgacaccatcggcaagttcgagtacacggacaggctgggcggc ctcatccactcggcgcaccccatcgtgacggacaccgagttctggacgctcatcccggacctcatccgcccgggctactcggtggtgaggatggacgccgggaccaacgagcggcgg ttcgtcggcagggtggactgtcggggcgggccggcgcccgggtgggtgcactcgttccccatcaccgaccactacgtggtggtgccggagatgccgctccggtactgcgccaggaac ctcctccgcgcggagcccacgccgctgtacaagttcgagtggcacctcgagtccggcagctacatgcacgtcatgtgcaaggctagcggcagggtcgtggcgaccgtggaggtgccg ccgttcgtcacgttccacttcatcaacgcgtacgaggagaaggacgacgagggccgcgtcaccgcgatcatcgccgactgctgcgagcacaacgccaacacctccatcctcgacaag ctccggctccagaacctgcgctcttccaccggccaggacgtcctccccgacgccaggatcccgctggacgggagcccgttcggcgagctggagccggcgctggacccggaccagcac ggccgcgggatggacatgtgcagcatcaacccggcccacgtcggcaagaagtaccggtacgcctacgcctgcggagcccaccggccgtgcaacttccccaacaccctcaccaagatc gacctggtggagaagacggccaagaactggtacgaggagggcgccgtgccgtcagagcccttcttcgtgccgcgccccggcgccgtggaggaggacgacggcgtcgcgatctcgatg gtgagcgccaaggacggatcggcctacgcgttggtgctggacgccaagacgttccacgagatcgcgcgggccaagttcccgtacgcgatgccctacggcttgcactgctgctgggtg cctaggagtacctcagacgcgtag
ZmCCD8b	atggcggtcggccgtcgtccatgtccatgtctgccggcgcacggaccgcaacatcagtgggcaccagctctaaggccttggttcggtgacctcctggggcgtctgtcgtccacgatg gacggagcgtccagggccctcaaggatgcgccgcagaggtttctcgatgcgctggttgacgcaaccttcagattcaccgatcaagctctgaattccgccgagagcaatttcgcaccg gtcgatgagactggtgaagccatagagatacaccagagccagatccaaggggcgataccggacggtttccccgaggggtgtacatcagaaacggttccaacccgctctttggcgcc ctccattccacgtcctcggtcctgggacagtccagggagatctgggtcgaggggggagggcatgctccacgccgtctacttcaccaaaagcagcgcgggtcatctatggtcagtctcc tacgccagccgctacgtgcagtccgagacgctggagctggaaacggcgcggcacaaaccttgcttcctccctgccgtcgagggcgactctgcagccatcgtcgccgcctacgttttc aactatcttaggtttggcaaggtgagcaaggacatcagcaacaccaacgtgttcgagcattccggcagggtgttcgccgtcgccgagaactctctgccctacgagatctgcgtaggt agcctcgacaccagagacgcctgggacgttggtggggaatgggatcgccccttcacggctcatccaaaggtagctcctggatcaggggagctcgtcatctttggaacggacgcgaag aagccattcctagtagttggagttgtctcagctgatggaaccaaactaaagcacagagctgacctcaagctggacaggtgcacactttgtcatgatataggagtcactccaaagcac aatgtaatcatggacataccacttaccatggacgtcggtagaatcgtcaaaggcggacagctgattcagttcgagaaggaaagctatgcgagaatcggggtgatgccccgctatggc gacgcagattcagctgtctggtttgatgtagaaccgttctgcatgttccatcttgtgaactgcttcgaagaaggcgacgaggtcgtggtacaggcactccgttcgccggactccata ataccaggctcaacaattgccctcgacaagctcgactctgaaatgcctgaggttgcaggagatgacaagcccgcgaaacggccaactgccgaggagtttttctttcggttgtaccag tggagattgaacttgagaacaaggagtgtctcaggggagtatctatctgggacagactattcgctggagtttccgatcatcagtagccagtacacgggcttgcagcacagatacgcc tatgcgcaagtggtggactcctgtggcaattgtgggaaagtaaacccaaagtatggaggatttgcaaaattctaccttgacgagagaagcaacgcagaggtgcacatagttgatgcg aagagattcgaggatgctcctgtcgcgaaaataacgtttccacgaagagtgccttatggctttcatggaactttcgtcagaaaccaaatgtactacataaataactcatga

Table S1. Open reading frames of all genes encoding carotenoid dioxygenases found in maize (*Zm*). Accession numbers are listed in Table 1. The sequences were obtained by manual curation of the available maize genomic sequences. Nucleotide sequence information for *Oryza sativa* and Sorghum bicolor can be obtained from the rice genome browser (http://rice.plantbiology.msu.edu/cgi-bin/gbrowse/rice/) using locus numbers listed in Table 1 as a search tag.. *Sorghum bicolor* sequences can be obtained specifically from Phytozome using rice locus number as a bait in its search finder (http://www.phytozome.org/search.php?show=text). Other sequences used in the present work can be obtained by selecting different nodes on an evolutionary tree generated in Phytozome.

ZmNCED1	MQGLAPPTSVSIHRHLPARSRARASNSVRFSPRAVSSVPPAECLQAPFHKPVADLPAPSRKPAAIAVPGHAAAPRKAEGGKKQLNLFQRAAAAALDAFEEGFVANV LERPHGLPSTADPAVQIAGNFAPVGERPPVHELPVSGRIPPFIDGVYARNGANPCFDPVAGHHLFDGDGMVHALRIRNGAAESYACRFTETARLRQERAIGRPVFP KAIGELHGHSGIARLALFYARAACGLVDPSAGTGVANAGLVYFNGRLLAMSEDDLPYHVRVADDGDLETVGRYDFDGQLGCAMIAHPKLDPATGELHALSYDVIKR PYLKYFYFRPDGTKSDDVEIPLEQPTMIHDFAITENFVVVPDHQVVFKLQEMLRGGSPVVLDKEKTSRFGVLPKHAADASEMAWVDVPDCFCFHLWNAWEDEATGE VVVIGSCMTPADSIFNESDERLESVLTEIRLDARTGRSTRRAVLPPSQQENLEVGMVNRNLLGRESRYAYLAVAEPWPKESGFAKEDLSTGELTKFEYGEGRFGGE PCFVPMDPAAAHPRGEDDGYVLTFVHDERAGTSELLVVNAADIRLEATVQLPSRVPFGFHGTFITGQELEAQAA
ZmNCED2	SAPWGGPCSPRPSARKNGHSGIARLALFYARGLCGLVDASRGTGVANAGLVYFNGRLLAMSEDDLPYQVRVTADGDLRTVGRYDFEGQLGCASMIAHPKLDPASGD LFALSYDVIRRPYLRYFYFRPDGTKSDDVEIPLEQPTMIHDFAITERFVVVPDHQVVFKLGEMLRGGSPVVLDQGKTSRFGVLPKYARDASEMVWVDVPDCFCFHL WNAWEEPGTGEVVVVGSCMTPADSIFNDDGGEDGRLQSVLTEIRLDTRTGASTRRAVLPPSAQVNLEVGMVNRNMVGRRTRYAYLAVAEPWPKVSGFAKVDLDTGD LVRFDYGDGRFGGEPCFVPTEGAPARGEDDGYILSLVRDERAGTSELLVVNAADMRLEATVQLPSRVPYGFHGTFIGERELEAQA
ZmNCED3a	MASSISAPAPPAAPATAPASGRPKKPSQFNPSTGKTRTPVPARPMRAAAPKWNPLQRLAAAALDALEEGLVAGVLERAHPLPRTADPAVQIAGNYAPVGERPPTGE LPVSGRVPACLDGVYVRNGANPLHAPRAGHHLFDGDGMLHAVRLRGGRAESYACRFTETARLRQERAIGRAVFPKAIGELHGHSGVARLLLFGARSLCGVLDASQG IGVANAGLVYHNNRLLAMSEDDLPYHVRVTADGDLETAGRYDFGGQLDTAMIAHPKLDPATGELFALSYNVVSKPFLKYFYFTADGRKSPDVEIPVDAPTMMHDFA VTENHAIIPDQQIVFKLQEMVLGGSPVVYDRNKTARFGVLPKRATDASRLRWVDVPDCFCFHLWNAWEDEATGEVVVIGSCMTPADAVFNESAAGEESFRSVLSEI RLDPRTGTSSRRAVLSDADQVNLEAGMVNRQLLGRRTRYAYLAIAEPWPKVSGFAKVDLEAGTVDKFIYGDGRYGGEPCFVPRPDAPAGAAEDDGYVLCYVHDEAR GASEMLVVNARDMRAEAAVKLPGRVPYGLHGTFIAGKELQRQA
ZmNCED3b	MASSSISAPAPPAAPAPGRPKKQSQLNPSTGKTRTPVPARPMRAAPTPARHEAAAKWNPLQRLAAAALDALEEGLVAGVLERAHPLPRTADPAVQIAGNYAPVGER PPSGELPVSGRVPACLDGVYVRNGANPLHAPRAGHHLFDGDGMLHAVRLRGGRAQSYACRFTETARLRQERALGRAVFPKAIGELHGHSGVARLLLFGARSLCGVL DASQGIGVANAGLVYHNNRLLAMSEDDLPYHVRVTADGDLETAGRYDFGGQLDAAMIAHPKLDPATGELFALSYNVVSRPFLKYFYFTADGRKSPDVEIPVDAPTM MHDFAVTENHAIIPDQQIVFKLQEMVLGGSPVVYDRNKTARFGVLPKRATDASRLQWVDVPDCFCFHLWNAWEDEATGEIVVIGSCMTPADAVFNESAGEESFRSV LSEIRLDPRTGTSSRRAVLSDADQVNLEAGMVNRQLLGRKTRYAYLAIAEPWPKVSGFAKVDLEAGTVEKFVYGEGRYGGEPCFVPRPDAPAAEDDGYVLCYVHDE GRGASEMLVVNARDMRAEAAVKLPSRVPYGLHGTFIAGKELQRQA
ZmNCED9	MQGLAPPTSVSIHRHLPAGSRARASNSVRFSPRAVRSVPHECLQAPFHADLPAPSKKPTAIAVPRHAAAPRKSGGGGGKKQLNLFQRAAAAALDAFEEGFVANVLE RPRGLPSTADPAVQIAGNFAPVGERLPVHRLPVSGRIPPFISGVYARNGANPCFDPVAGHHLFDGDGMVHALRIRDGVAESYACRFTETARLTQERAVGRPVFPKA IGELHGHSGIARLALFYARAACGLVDPSAGTGVANAGLVYFNGRLLAMSEDDLPYHVRVADDGDLETVGRYDFDGQLGCPMIAHPKLDPATGELHALSYEVVRRPY LKYFYFRPDGTKSDDVEIPLAQPTMIHDFAITENLVVVPDHQVVFKLQEMLRGGSPVVLDREKTSRFGVLPKRAADASEMAWVDVPDCFCFHLWNAWEDEATGEVV VIGSCMTPADSIFNESDVRLESVLTEIRLDARTGRSTRRAVLPPSRQVNLEVGMVNRNLLGRRTRYAYLAVAEPWPKVSGFAKVDLATGELARFEYGEGRFGGEPC FVPMDPAAAHPRGEDDGHVLAFVHDERAGTSELLVVNAADMRLEATVRLPSRVPFGFHGTFITGAELEAQA
ZmCCD1	MGTEAEQPDMDSHRNDGVVVVPAPRPRKGLASWALDLLESLAVRLGHDKTKPLHWLSGNFAPVVEETPPAPNLTVRGHLPECLNGEFVRVGPNPKFAPVAGYHWFD GDGMIHAMRIKDGKATYVSRYVKTARLKQEEYFGGAKFMKIGDLKGFFGLFMVQMQQLRKKFKVLDFTYGFGTANTALIYHHGKLMALSEADKPYVVKVLEDGDLQ TLGLLDYDKRLKHSFTAHPKVDPFTDEMFTFGYSHEPPYCTYRVINKEGAMLDPVPITIPESVMMHDFAITENYSIFMDLPLLFRPKEMVKNGEFIYKFDPTKKGR FGILPRYAKDDKLIRWFQLPNCFIFHNANAWEEGDEVVLITCRLENPDLDKVNGYQSDKLENFGNELYEMRFNMKTGAASQKQLSVSAVDFPRVNESYTGRKQRYV YCTILDSIAKVTGIIKFDLHAEPESGVKVLEVGGNVQGIYDLGPGRFGSEAIFVPKHPGVSGEEDDGYLIFFVHDENTGKSEVNVIDAKTMSADPVAVVELPNRVP YGFHAFFVTEDQLARQAEGQ
ZmCCD4a	MERTLITSNLCLSAHASRSSRRVHYIPPSASAAAHNSSYRKKSAPSLPPSAAASATVVTAPPSTDNVQSTAPKQTGRQELEDLVAAKTSTSRTARAPSQARARARA EPRRRPAPAATSLPMAFCSALEEAINTFVDPPALRPSVDPRNVLSTNFAPVDELPPTPCPVVRGAIPRCLAGGAYIRNGPNPQHLPRGPHHLFDGDGMLHSLLLPT AGSPPSSDPVLCSRYVQTYKYLVERDAGAPVMPNVFSGFHGVAGLARGAVVAARVLTGQMNPAEGVGLANTSLAFFGGRLYALGESDLPYTVRVDPATGEVTTHGR CDFGGRLFMGMTAHPKKDPVTGEVFAFRYGPVPPFVTYFRFDPAGNKGPDVPIFSVQQPSFLHDFAVTERYAIFPEIQIVMQPMGMVTGGAPVGSDSGKVPRLGVL PKYATDESEMRWFEVPGFNMMHSLNAWEEADGEELVLVAPNVLSVEHALERMELVHSCVEKVRMNLRTGAVSRTPLSAGNLDFGVIHPGYLGRRNRYGYLGIGDPM PKISGVAKLDLDRAGTGDCTVARRDFGPGCFAGEPFFVPDDVEGDGNEDDGYLVCYVHNERTGENQFVVMDARSPQLDIVAEVQLPARVPYGFHGMFVTQAELQAQ QQ
ZmCCD4b	MERTLITSNLSMSAHASRSSRRVHYISPAASAAAHNSSYRKKKKNAPSPPPSAAATDTVVISPPATDNVQSTAPKQAGRQELEELVAAKTNTSRIATARTSASSQS RAKLRRRPAPAITSLPMAFCSALEEAINTFVDPPVLRPSVDPRNVLSTNFAPVDELPPTPCPVVRGAIPRCLAGGAYIRNGPNPQHLPRGPHHLFDGDGMLHSLLL PTAESPSSDPVLCSRYVQTYKYLVERDAGAPVMPNVFSGFHGVAGLARGAVVAARVLTGQMNPAEGVGLANTSLVFFGGRLYALGESDLPYTVRVDPATGEVTTHG RCDFGGRLFMGMTAHPKKDPVTGEVFAFRYGPVPPFVTYFRFDRAGNKGPDVPIFSVRQPSFLHDFAVTERYAIFPEIQIVMQPMGMVTGGAPVGSDAGKVPRLGV LPKYATDESEMRWFEVPGFNIMHSLNAWEEADGEELVLVAPNVLSLEHALERMELVHSCVEKVRINLRTGAVSRTPLSAENLDFGVIHPGYLGRRNRYGYLGIGDP MPKIAGVAKLDLDRAGTGDCTVARRVFGPGCFAGEPFFVPDDVEGNSNEDDGYLVCYVHNERTGENQFVVMDARSAQLDIVAEVQLPARVPYGFHGIFITQAELQA QQQ
ZmCCD7	MAAMHAIVHHRAPPPGRCCRGHGRSVVVRASAATVTTSIPGSAATVPDSPSAAFWDYNLLFRSQRAESPDPVVLRVTEGAIPPDFPAGTYYLAGPGMFTDDHGSTV HPLDGHGYLRSFRFDASGAAHYSARYVETAAKREEHDAGGASWRFTHRGPFSVLQGGSRVGNVKVMKNVANTSVLRWGGRVLCLWEGGEPYELDPRTLETIGPFDI

Table S2 -p1

	LGSLCGGTDEVARDASGEAAHHGRRQPWLQEAGIDVAARLLRPVLSGVYSMPAKRLLAHYKIDPKKNRLLMVACNAEDMLLPRSNFTFYEFDANFALVQKREFVLP DHLMIHDWAFTDSQYVLLGNRIRLDIPGSLLALTGTHPMIAALAVDPSRQSTPVYLLPRTPEAEAEASGRDWSVPIEAPSQMWSMHVGNAFEERNARGGINIQLHM SGCSYQWFNFHRMFGYNWLNKKLDPSFMNIAKGREWLPRLVQVSIDLDKRGTRRGCAVRRLSDQWTRPADFPAINPGFANRRSRFVYAGAASGSRRFLPYFPFDSV VKVDVSDGSARLWSVAGRKFVGEPVFVPTGSGEDDGYVLLVEYAVYDHRCHLVLLDARKIGERNAVVAKLEVPKHLTFPMGFHGFWADE
ZmCCD8a	MSGASGRPSAGGSAVPGRLSSSTQGGKGKRAVVQPLAASVVTETPAPAVAPARPVVDAPPRRRGGRGTVEHAAWKSVRQERWEGALELEGELPLWLDGTYLRNGPG LWNLGDYGFRHLFDGYATLVRVSFRDGQAVGAHRQIESEAYKAARAHGKVCYREFSEVPKAEGFLSHVGQLATLFSGSSLTDNSNTGVVRLGDGRVLCLTETIKGS IVVDPDTLDTIGKFEYTDRLGGLIHSAHPIVTDTEFWTLIPDLIRPGYSVVRMDAGTNERRFVGRVDCRGGPAPGWVHSFPITDHYVVVPEMPLRYCARNLLRAEP TPLYKFEWHLESGSYMHVMCKASGRVVATVEVPPFVTFHFINAYEEKDDEGRVTAIIADCCEHNANTSILDKLRLQNLRSSTGQDVLPDARIPLDGSPFGELEPAL DPDQHGRGMDMCSINPAHVGKKYRYAYACGAHRPCNFPNTLTKIDLVEKTAKNWYEEGAVPSEPFFVPRPGAVEEDDGVAISMVSAKDGSAYALVLDAKTFHEIAR AKFPYAMPYGLHCCWVPRSTSDA
ZmCCD8b	MAVGRRPCPCLPAHGPQHQWAPALRPWFGDLLGRLSSTMDGASRALKDAPQRFLDALVDATFRFTDQALNSAESNFAPVDETGEAIEIHQSQIQGAIPDGFPEGVY IRNGSNPLFGALHSTSSVLGQSREIWVEGEGMLHAVYFTKSSAGHLWSVSYASRYVQSETLELETARHKPCFLPAVEGDSAAIVAAYVFNYLRFGKVSKDISNTNV FEHSGRVFAVAENSLPYEICVGSLDTRDAWDVGGEWDRPFTAHPKVAPGSGELVIFGTDAKKPFLVVGVVSADGTKLKHRADLKLDRCTLCHDIGVTPKHNVIMDI PLTMDVGRIVKGGQLIQFEKESYARIGVMPRYGDADSAVWFDVEPFCMFHLVNCFEEGDEVVVQALRSPDSIIPGSTIALDKLDSEMPEVAGDDKPAKRPTAEEFF FRLYQWRLNLRTRSVSGEYLSGTDYSLEFPIISSQYTGLQHRYAYAQVVDSCGNCGKVNPKYGGFAKFYLDERSNAEVHIVDAKRFEDAPVAKITFPRRVPYGFHG TFVRNQMYYINNS
OsNCED2	MPTTFTPNSPASSCSIHHRASPSRGARNSVRFTRPRAAAAATNSVLSAPSSVPPAYVPPPPPPPTKMFPEAGDAAAAKAAARRCGKKKDGLNFFQRAAAVALDAFE EGFITNVLERPHALPRTADPAVQIAGNFAPVGEQPPVRSLPVSGRIPPFINGVYARNGANPHFEPTAGHHLFDGDGMVHAVRIRNGAAESYACRFTETARLGQERA LGRAVFPKAIGELHGHSGIARLALFYARGLCGLVDPSHGTGVANAGLVYFNGRLLAMSEDDLPYQVRVTADGDLETVGRYDFDGQLGCAMIAHPKLDPVSGELFAL SYDVIKKPYLKYFYFDADGTKSPDVEIELEQPTMIHDFAITENFVVVPDHQVVFKLGEMFRGGSPVVLDREKTSRFGVLPKHATSSLEMVWVDVPDCFCFHLWNAW EEAESGEVVVVGSCMTPADSIFNESDEHLESVLTEIRLNTRTGESTRRAVLPPAAQVNLEVGMVNRAMLGRKTRYAYLAVAEPWPKVSGFAKVDLATGELTKFEYG EGRFGGEPCFVPMGGAGAAASPARGEDDGYILSFVRDEAAGTSELLVVNAADMRLEATVQLPSRVPYGFHGTFINAGELATQA
OsNCED3a	MASSAPSAPGLAPVAKPPPPPSKVKVATATVPTNGKIKQGARPMRVSAPPVEPRRRMNPLQRLAAAAIDAVEEGLVAGLLERGHALPRTADPAVQIAGNYAPVGER PPVRGLPVSGRLPACLDGVYVRNGANPLHAPRAGHHLFDGDGMLHAVRLAGGRAESYACRFTETARLRQEREMGRPVFPKAIGELHGHSGVARLLLFGSRALCGVL DASRGIGVANAGLVYHDGRLLAMSEDDLPYHVRVTHDGDLETVGRYDFHGQLDADGTMIAHPKLDPVTGELFALSYNVVSKPYLKYFYFTADGRKSRDVDIPVGAP TMIHDFAVTENYAVVPDQQIVFKLQEMVRGGSPVVYDREKASRFGVLPKRAADASELRWVEVPGCFCFHLWNAWEDDATGEIVVIGSCMTPPDAVFNEPSQSPEEE SFRSVLSEIRLDPRTGVSRRRDVLRDAAEQVNLEAGMVNRQLLGRKTRYAYLAIAEPWPRVSGFAKVDLESGTAEKFIYGEGRYGGEPCFVPRAGAAAEDDGHVLC FVHDEERGTSELVVVDAGSEAMEEVAAVKLPGRVPYGLHGTFIGANELQRQA
OsNCED9	MATITTPGYAHIQRQHGRCSTTAGRRGASNSVRFSARAVSSVPHAAAASSAPAFLPVPFVPGADAPSPSGKSAIGVPKAPRKGEEGKRLNFFQRAAAMALDAFEEG FVANVLERPHGLPSTADPAVQIAGNFAPVGETPPARALPVSGRIPPFINGVYARNGANPHFDPVAGHHLFDGDGMVHAVRIRNGAAESYACRFTETARLRQERAMG RPMFPKAIGELHGHSGIARLALFYARAACGLLDPSHGTGVANAGLIYFNGRLLAMSEDDLPYQVRVTADGDLETVGRYDFDGQLGCAMIAHPKLDPATGELHALSY DVIKKPYLKYFYFAPDGTKSADVEIPLDQPTMIHDFAITENYVVVPDHQVVFKLQEMLRGGSPVVLDKEKTSRFGVLPKHAADASEMVWVDVPDCFCFHLWNAWEE ADTDEVVVIGSCMTPADSIFNESDDRLESVLTEIRLNTRTGESTRRAILPPSSQVNLEVGMVNRNLLGRKTRYAYLAVAEPWPKVSGFAKVDLATGELTKFEYGEG RFGGEPCFVPMDAAAATPRGEDDGYILSFVHDERAGTSELLVVNAADMRLEATVQLPSRVPYGFHGTFITGDELTTQA
OsCCD1	MGGGDGDEVLLLPEPRPRRGLASWALDLLERAAVRLGHDASKPLYWLSGNFAPVHHETPPAPALPVRGHLPECLNGEFVRVGPNPKFVPVAGYHWFDGDGMIHAMR IKDGKATYVSRYVKTSRLKQEEYFGGAKFMKIGDLKGFYGLFMVQMQQLRKKLKVLDFTYGHGTANTALIYHHGKLMALSEADKPCKFSSHNDVVKVLEDGDLQTL GLLDYDKRLKHSFTAHPKVDPFTDEMFAFGYSHEPPYCTYRVITKDGAMLDPVPITIPESVMMHDFAITENYSIFMDLPLLFRPKEMVKNGEFIYKFDPTKKARFG ILQRYEKDDTNIRWFELPNCFIFHNANAWEEGDEVILITCRLENPDLDKVNGYQSDNLENFGNELYEMRFNMKTGAASQKQLSVSAVDFPRINESYTGRKQRYVYC AILNSIAKVAGIIKFDLHAEPEISGKKQLEVGGNVRGIFDLGPGRFGSEAIFVPREPGVSGEEDDGYLIFFVHDENTGKSEVNVIDAKTMSADPVAVVELPSRVPY GFHAFFINEEQLAKQSA
OsCCD4a	MQRICPAHCSVTHSLTMKSMRLSYIPPAASAAPQSPSYGRKKNASAAPPSAAASTTVLTSPLVTTTRTPKQTEQEDEQLVAKTKTTRTVIATTNGRAAPSQSRPRR RPAPAAAASAASLPMTFCNALEEVINTFIDPPALRPAVDPRNVLTSNFVPVDELPPTPCPVVRGAIPRCLAGGAYIRNGPNPQHLPRGPHHLFDGDGMLHSLLLPS PASSGDDPVLCSRYVQTYKYLVERDAGAPVLPNVFSGFHGVAGMARGAVVAARVLTGQMNPLEGVGLANTSLAYFAGRLYALGESDLPYAVRVHPDTGEVTTHGRC DFGGRLVMGMTAHPKKDPVTGELFAFRYGPVPPFVTYFRFDPAGNKGADVPIFSVQQPSFLHDFAITERYAIFPEIQIVMKPMDMVVGGGSPVGSDPGKVPRLGVI PRYATDESEMRWFEVPGFNIMHSVNAWEEAGGEELVLVAPNVLSIEHALEHMELVHSCVEKVRINLRTGVVTRTPLAAGNFDFPVINPAFLGRRNRYGYFGVGDPA PKIGGVAKLDFDRAGEGDCTVAQRDFGPGCFAGEPFFVADDVEGNGNEDDGYLVCYVHDEATGENRFVVMDARSPDLEIVAEVQLPGRVPYGFHGLFVTQAELQSQ HQ
OsCCD4b	MEVPIAAMTFAHPANVMTLASRQPKSKRSHISPATTAHRNLQTRLAHHHHATPASLPMAICNTVDKVINRFIDLPEQRPTVDPRRVLSGNFAPVDELPPTSCHVIR GSIPSCLAGGVYIRNGPNPQHRLPQRTHHLFDGDGMLHSLLIPSASSTLLSEPVLCSRYVHTYKYLLERETGGPVLPNFFAGFHGVAGLARAVVMIARVLAGQINL NKGFGLANTSITLFADCLYALCESDLPYSMHINPANGEVTTLGRCDFGGDLSFRMTAHPKKDPVTMELFAFRYNVFQPFITYFWFDRAGSKVADVPILSLQKPSVM

Table S2 -p2

	HDFAITERYAIFPESQLIVNPMDMVMRGSSLVGLDRTMVPRIGVLPRYAKDESDMRWFEVPRFNMLHTTNGWEEADGEEIVLVAPNILSIEHMLGNMELMRARVDM VRINLCTGDVSCTALSPESLEFGVIHQGYVGRKNRYGYFGVSGPLPKIKGIRKLDFDLVGSGDCTVGRRDFGLGCFAGEPFFVPDNIDGYGNEDSGYVVCYTHEED TGESWFVVMDAKSPELDIVAEVQLPSRIPYGFHGIFVKQAELLAQQ
OsCCd7	MATQAIAPMHAAVVHRHHVLPPRRCVRRRGVFVRASAAAAAAAAETDTLSAAFWDYNLLFRSQRDECLDSIPLRVTEGAIPPDFPAGTYYLAGPGIFSDDHGSTVH PLDGHGYLRSFRFRPGDRTIHYSARFVETAAKREESRDGASWRFTHRGPFSVLQGGKKVGNVKVMKNVANTSVLRWGGRLLCLWEGGQPYEVDPRTLETVGPFDLL GLAAADDNKATNASAARRPWLQEAGLDAAARLLRPVLSGVFDMPGKRLLAHYKIDPRRGRLLMVACNAEDMLLPRSHFTFYEFDAHFDLVQKREFVVPDHLMIHDW AFTDTHYILLGNRIKLDIPGSLLALTGTHPMIAALAVDPRRQSTPVYLLPRSPETEAGGRDWSVPIEAPSQMWSVHVGNAFEEANRRGGLDVRLHMSSCSYQWFHF HRMFGYNWHHKKLDPSFMNAAKGKEWLPRLVQVAIELDRTGECRRCSVRRLSDQHARPADFPAINPSYANQRNRFVYAGAASGSRRFLPYFPFDSVVKVDVSDGSA RWWSTDGRKFVGEPVFVPTGGGEDGGYVLLVEYAVSKHRCHLVVLDAKKIGTENALVAKLEVPKNLTFPMGFHGFWGDE
OsCCD8a	MSPAMLQASSLCVSAALSGAASRPGRLASQGHQGKRAVAQPLAASAVTEAAPPAPVVAPPARPVDAPRRRGGRGGGGGGGELVAWKSVRQERWEGALEVDGELPLW LDGTYLRNGPGLWNLGDYGFRHLFDGYATLVRVSFRGGRAVGAHRQIESEAYKAARAHGKVCYREFSEVPKPDNFLSYVGQLATLFSGSSLTDNSNTGVVMLGDGR VLCLTETIKGSIQVDPDTLDTVGKFQYTDKLGGLIHSAHPIVTDTEFWTLIPDLIRPGYVVARMDAGSNERQFVGRVDCRGGPAPGWVHSFPVTEHYVVVPEMPLR YCAKNLLRAEPTPLYKFEWHLESGSYMHVMCKASGKIVASVEVPPFVTFHFINAYEETDEEGRVTAIIADCCEHNANTAILDKLRLHNLRSSSGQDVLPDARVGRF RIPLDGSQFGELETALDPEEHGRGMDMCSINPAHVGREYRYAYACGARRPCNFPNTLTKVDLVERTAKNWHEEGSVPSEPFFVPRPGATEEDDGVAISMVSAKDGS GYALVLDGKTFEE
OsCCD8b	MMTASLHPCVCKASPAFRPASSLGARTQPKSTATNPKRPLFQELQRRLSFRIDEASKALETAKQGLLDALVDSTFKFSDQPMLPSENNFAPVNEISEAIEILQIEG EIPEDFPEGSNPLFGALHSTVSIFGKSSEIWVEGEGMLHAIYFTKNSSDTWSVSYANRYVQSETLKIEKTRQKPCFLPAIMGDSAAIVAAYILNYMRFGKVNKNIS NTNVFEHAGKVYAVSENHLPQEISIQNLDTGDSWDINGEWKRPFTAHPKVAPGSGELVIFGSDAKRPFLMVGVVSADGTQLKHKVDLKLDRCILCHDIGVTVKYNI IMDIPLTIDISRLIRGNQLIKFEKDSYARIGVMPRYGDAESVMWFDVEPFCMFHFINCFEEGDEVVIRGFRAADSIIPGPRISLNKNDLLSDPSKCSVKQGINEEF FSRLYQWRLNTKTKAVSGQYLSGTEFSMEFPVINDHYTGLHHSYAYAQVVDSLESSYGVNEKVILKYGGLAKLCLEEADNVIAEVHIIDAQTFEGAPVAKIVLPQR VPYGFHGTFRSSLANTMT
OsCCD8c	MATSLTLIATPCTAPRSSSSFALAPRLPPRCSNATAARRRAVRATTLQSDQEPAGSGDSGATTTKLSASTSVRQERWEGDLPIEGCLPPWLNGTYIRNGPGMWDVG EHAFHHLFDGYATLVRVSFRGGGGARATGAHRQIESEAYRAAVARGRPVLREFSHCPAPAKSLLHRFGDLVGLVTGAALTDNPNSAVLPLGDGRVMCLTETTKSSV LIDPDTLETVGRFRYTDRLGGMVQSAHPIVTDTEFLTLLPDLVRPGHLVVRMEAGSNERKVIGRMDCRGGPSPGWLHSFAVTEKYAVVPEMPLRYSSASLLASELA PFYAFDWVPASGSYMHVMCKSTGKTVASVEVPPFMAIHFINAYEEEGDEAAVVVDCCEHYGDPAIIETLVLSRLRLLRGKDVLPNARVGRFRIPLDGSPFGELETA LDPEEHGRGMDMCSINPARLGRKYQYAYACGARRPCNFPNTLTKIDLVEKKAKSWHEEGSVPSEPFFVARPGATDEDDGVVISIVSSDDGEGYALVLDATTFEEIA RVRFPYGLPYGFHGCWIPATEE
OsCCD8d	MYTLQPRVCISSSRSSISPKAARLSHQKASTGKPYFREIQVHLSSKLGEASNAMNSTYQQLLDSFVDHTFTFKCQPLRPTESNFAPVDEIGEITRVIEIEGEIPAD FPEGVYIRNGGNPLYGGLQSVSSIFGQSHNIWVEGEGMLHAVYFCKSNNSTWSISYNNRYVQSETFRIEKERQKPCFLPMTDGNPPAMLIASVLNTLRFRKVMKSM SNTSVFEHAGRVYAASEDDVPHEVDLHNLSTLGSWHLGGEWKLPFTAHPKVIPGSKEMVIFGINAVQPFLTVGIISEDGEKLKQKVGLKLDRCTYCHEIGVTGTYN IIIDSPLTLNPTRMLRGAPVLEFEEESYSRIGVMPHYGDADSVIWFYVEPFCTFHLVNCFEEGHEVVVRGFHVPSSAIMGPRQKNMVMDTSSQEPNEENFSRLYEW RLNLKTRTVAGKYLTSLDVALEFPVINDKFSGLRHSLNLAARPKFIGFAKLCLEEKQNIATKIDREDLIKVEYHQLAKNQFCSGVTFVPKAAGAHEDDGWIVSFVH DEETNISKVHIIDARNFESEPIAKIILPQRVPYGLHGAFITKRT
SbNCED2	MGRGGIWEKGEEEKAAVMVTVQGAVLSGAHLASLLPSPGVHHDDLPYQVRVTGDGDLRTVGRYDFDGQLAGCASMIAHPKLDPASGELFALSYDVIKRPYLRYFYF RADGTKSDDVEIPLEQPTMIHDFAITERFVVVPDHQVVFKLGEMFRGGSPVVLDESKTSRFGVLPKYARDSSEMVWVDVPDCFCFHLWNAWEDEATGEVVVIGSCM TPADSIFNDDDSDRRLQSVLTEIRLDTRTGASTRRAVLPASAQVNLEVGMVNRGMLGRKTRYAYLAVAEPWPKVSGFAKVDLATGDLVRFDYGEGRFGGEPCFVPT EGAPARGEDDGYILTLVRDERAGTSELLVVNAADMRLEATVQLPSRVPYGFHGTFIGDRELEAQA
SbNCED3a	MASSISVPAPPAAPATAAPSQARPKKPSQLNLTTGKTKTPVPARPMRAVPEWNPLQRLAAAALDAVEEGLVAGFLERAHPLPRTADPAVQIAGNYAPVGERPPTGD LPVSGRVPACLDGVYVRNGANPLHAPRAGHHLFDGDGMLHAVRLRAGRAESYACRFTETARLRQERAIGRPAIGELHGHSGVARLLLFGARSLCGLLDASRGVGVA NAGLVYHDNRLLAMSEDDLPYHVRVTADGDLETVGRYDFGGQLDTAMIAHPKLDPATGELFSLSYNVVTKPFLKYFYFTADGRKSPDVEIPVDAPTMMHDFAVTEN HAIIPDQQIVFKLQEMLLGGSPVVYDKNKTARFGVLPKRATDASRLQWVEVPDCFCFHLWNAWEDDATGDIVVIGSCMTPADAVFNESAAGEESFRSVLSEIRLDP RTGTSSRRAVLSDADQVNLEAGMVNRQLLGRKTRYAYLAIAEPWPKVSGFAKVDLEAGTVEKFIYGEGRYGGEPCFVPRPDAPAGAAEDDGYVLCYVHDEGRGASE MLVVNARDMRAEAAVKLPGRVPYGLHGTFIVGEELQRQA
SbNCED9	MQSLAPPTSVSIHRQHLPASGSSRARASNSVRFSPRAVSSVPRATAPAERLQAPFHKPGAADLPAQSKKPATAIAVPRHAAAPRKAGGKKQLNFFQRAAAAALDAF EEGFVANVLERPHGLPSTADPAVQIAGNFAPVGERPPVRELPVSGRIPPFINGVYARNGANPCFDPVAGHHLFDGDGMVHALRIRNGVAESYACRFTETARLTQER AIGRPVFPKAIGELHGHSGIARLALFYARAACGLVDPSAGTGVANAGLVYFNGHLLAMSEDDLPYHVRVADDGDLETVGRYDFDGQLGCAMIAHPKLDPVTGELHA LSYDVIKKPYLKYFYFRPDGTKSDDVEIPLDQPTMIHDFAITENFVVVPDHQVVFKLQEMLRGGSPVVLDKEKTSRFGVLPKHASDASEMVWVDVPDCFCFHLWNA WEDEATGEVVVIGSCMTPADSIFNESDERLESVLTEIRLDTRTGRSTRRAVLPPSQQVNLEVGMVNRNLLGRKTRYAYLAVAEPWPKVSGFAKVDLETGELTKFEY GEGRFGGEPCFVPMDPSAAHPRGEDDGYVLTFVHDERAGTSELLVVNAADMRLEATVQLPSRVPFGFHGTFITGKELEAQA
SbCCD1	MGTEAEHQDSSVQHDGVVVVPAPRPRKGLASWALDLLESLVVRLGHDKTKPLHWLSGNFAPVVEETPPAPNLTVRGHLPECLNGEFVRVGPNPKFVPVAGYHWFDG

	DGMIHAMRIKDGKATYVSRYVKTARLKQEEYFGGAKFMKIGDLKGFFGLFMVQMQQLRKKFKVLDFTYGFGTANTALIYHHGKLMALSEADKPYVVKVLEDGDLQT LGLLDYDKRLKHSFTAHPKVDPFTDEMFTFGYSHEPPYCTYRVITKEGAMLDPVPITIPESVMMHDFAITENYSIFMDLPLLFRPKEMVKNGEFIYKFDPTKKARF GILPRYAKDEKVIRWFELPNCFIFHNANAWEEGDEVVLITCRLENPDLDKVNGHQSDKLENFGNELYEMRFNMKTGAASQKQLSVSAVDFPRVNESYTGRKQRFVY CTILDSIAKVTGIIKFDLHAEPESGKKELEVGGNIQGIYDLGPGRFGSEAIFVPKQPGVSGEEDDGYLIFFVHDENTGKSEVNVIDAKTMSADPVAVVELPNRVPY GFHAFFVTEDQLAQQAEGQ
SbCCD4a	MERTLITSNLSMSAHASRSSGRVHYISPAASAAAQNSSYRKKKKSAPSPPPSAAATATVVTSPPATDNVQSSAVKQTGRQELEELVATKANTSRIASAPSQAQARA QPRRRPAPAATSLPMAFCSALEEAINTFVDPPALRPSVDPRNVLSTNFAPVDELPPTPCPVVRGAIPRCLAGGAYIRNGPNPQHLPRGPHHLFDGDGMLHSLLLPT AESPSSDPVLCSRYVQTYKYLVERDAGAPVMPNVFSGFHGVAGLARGAVVAARVLTGQMNPAEGVGLANTSLAFFGGRLYALGESDLPYAVRVDPATGEVTTHGRC DFGGRLFMGMTAHPKKDPVTGEVFAFRYGPVPPFVTYFRFDPAGNKGPDVPIFSVQQPSFLHDFAVTERYAIFPEIQIVMQPMGMVAGGAPVGSDAGKVPRLGVLP KYATDESEMRWFEVPGFNIMHSLNAWEEADGEELVLVAPNVLSVEHALERMELVHSCVEKVRINLRTGAVSRTPLSAGNLDFGVIHPGYLGRRNRYGYLGIGDPMP KISGVAKLDLDRAGTGDCTVARRDFGPSCFAGEPFFVPDDVEGNGNEDDGYLVCYVHNERTGENLFVVMDARSPQLDIVAEVELPTRVPYGFHGIFVTKAELQAQQ Q
SbCCD7	MHAAVHHHHPGHRAPPPRRCSRGHGRSSVAVRAAAATTVTSTPGAAATAPDSPSASFWDYNLLFRSQRAECRDPVALRVTEGAIPADFPSGTYYLAGPGMFTDDHG STVHPLDGHGYLRSFRFGSDGAPARYSARYVETAAKREEHDAPRSSWRFTHRGPFSVLQGGTRVGNVKVMKNVANTSVLRWGGRVLCLWEGGEPYELDPRTLETIG PFDILGRLATGGEAARDDDSSEAARLGRRRPWLQEAGIDVAARLLRPVLGGVFSMPAKRLLAHYKIDQERNRLLMVACNAEDMLLPRSNFTFYEFDADFALVQTRE FVLPDHLMIHDWTFTDSHYVLLGNRIRLDIPGSLLALTGTHPMIAALAVDPSRQSTPVYLLPRSPEAEAPGRDWSVPIEAPSQMWSMHVGNAFEERNARGGINIQL HMSGCSYQWFNFHRMFGYNWQNKKLDPSFMNIAKGREWLPRLVQVSIDLDKRGTCRGCSVRRLSDQWTRPADFPAINPGFANRRNRFIYAGGASGSRRFLPYFPFD SVVKVDVADGSARSWSVAGRKFVGEPVFVPTGSSEDDGYVLLVEYAVSDHRCHLVVLDARKIGERDAVVAKLEVPKHLTFPMGFHGFWADE
SbCCD8a	MSPTMASSLCVFAAMSGATGRPSSTGGSVVPPGRLSSTAQGTKGKRAVVQPLAASVVTDTPTPTPAIAPAAPPARPVVDAPRRRGGRGTGEHAAWKSVRQERWEGA LELEGELPLWLDGTYLRNGPGLWNLGDYGFRHLFDGYATLVRVSFRNGHAVGAHRQIESEAYKAARANGKVCYREFSEVPKADSFLSHVGQLATLFSGSSLTDNSN TGVVRLGDGRVLCLTETIKGSIVVDPDTLDTLGKFEYTDKLGGLIHSAHPIVTDTEFWTLIPDLIRPGYSVVRMDAGTNERRFVGRVDCRGGPAPGWVHSFPITDH YVVVPEMPLRYCARNLLRAEPTPLYKFEWHLESGSYMHVMCKASGRVVASVEVPPFVTFHFINAYEEKDEEGRVTAIVADCCEHNANTTILDKLRLQNLRSSTGQD VLPDARVGRFRIPLDGSPFGELESALDPDQHGRGMDMCSINPAHVGKKYRYAYACGAQRPCNFPNTLTKIDLVEKTAKNWYEEGAVPSEPFFVPRPGAVEEDDGVA ISMVSAKDGSAYALVLDAKTFQEIARAKFPYAMPYGLHCCWVPRTTSDA
SbCCD8b	MVLKASASFSPSLPLPLSCRINGGRPSMSMSAGARTAASVGTSSQKPLLGELLGNLSSKMDRASKALKDVPQRFLDVLVDATFKFTDEALNPSESNFAPVDEIGEA IEIHQNQVEGAIPDDFPEGVYIRNGSNPLFGALHSTSSIFGQSREIWVEGEGMLHALYLTKNTSGSWSVSYANRYVQSETLKLETARQKPCFLPAIEGDSAAIIAA YIFNHLRFGKVNKDISNTNVFEHAGRVFAVAENHLPQEIGIDNLDTSGTWDVGGEWDRPAFTAHPKVAPGSGELVIFGMDAKRPFLVIGVVSADGTKLKHRVDLKL DRSTLCHDIGVTLKYGHNVIMDIPLTIDISRLVKGGQLIQFEKESYARIGVMPRYGDADSVVWFNVEPFCMFHLVNCFEEGDEGLRSPDSIIPGPRLAPNKCDSKM SELTEDDKPNEGTTKEFFFRLYQWRLNLKTKSVSGEYLTGTEFSFEFPIINNQYTGLQHSYAYAQIVDSCENCGKVNPKYGGFAKFYLDERNNTEVHIVDAKRFED APVAKITLPRRVPYGFHGTFISKKLIM
SbCCD8c	MATYPSTLGAAPKSFFLSNSLFNISLGTATPSRISSVKAAGECWTKHPAWTNVRQERWEGHLAVEGHLPTWLNGTYLRNGPGLWEVGDHSSHHIFDGYATLVRISF RRGCATGAHRQVESDAYKAARAHGRPLHREFSQLCPSEPGTLLDRVRDVVGLASGTLLTDNANVSVLPLGDGRVLCLTEATKGSVLIDPETLDTIGKFRYADRLWG LLQSAHPVVTGNELLTLLPDMFRRGHRVVRMAAGSNERKMVGRVHCRGGQAPGWVHSFAVTEKYIVVPEMPLRYSLAGVLKSQMTPWYLFDWLPESGSYMHAICRF TGKTVASVEVPPFMALHFINAYEQGDAIIADCCEYYADPSVIKALALRRLRSPGMNNDAFPDVRVARFSIPLDGTLMGELETVLDPEVHGRGVEMPSINPAYQGKE YRYVYACSARRPCNFLNCLTKIDLGEKEAKNWHELGSVPSEPFFVARPGGSDEDDGVVISIVSTMEGDGYALLLDAMTFQEIARVRLPYGLPYGFHGCWIPENV
SbCCD8d	MFRAGLKPTTTSSSSRCIHSRRAPDHALPFNPPNAIKGNFRPVNEMDEAVLLNNLDGEVPGDFPEGVYIRNGPNPLNPTQTIADSIFGSTSYMYYEGHGMLHAVYF DKSSLGEWKISYRNKYVNSDTFQLERKNQVAFVPSADGQPYATLVAFVLNILRFEKAVKDSANTNIFEHAGRAFAVTENHLPYEINISNLNTLGPYNINGAWNQPF TSHPKKIHESGELVMMGTNPEKPHYVLGVISPDGERLVHKADLKFEEGKLIHDIGVTKRYNIIMDYPLRFGISRTFLRKPFIENDMNGKSRIGVMPRFGDAESIIW FDVENHCSYHLFNCFEDENEVVIRGCRLLGSIIPSGRHRVDKSKWYGRAFLQPDKDSEDFDPSLDGTLFSRPYEWRLNLENGSVHEGYITSEKVAMDFPVISDKFV GVQNKYGYAQVADSLATSKTGLFKFKMIAKLHFNMPDKKNGIDEDDGWIVTYVHDEGTNSSQVYIIDAKRFSEEPVAKITLPQRVPYGFHGNFFYTSNQR
SbCCD8c-like	MAACKLPTLCTAPTPYLYASRRSAGQTIISTAAASACHRCRASRRRIQAAGDCTKHSAWTSIRHERWEGDLAIEGHIPAWLNGTYLRNGPGVWEVGDHALDHVFDG YATLVRVYFQGARGRATGAHRQIESDAYKAAARAHGRRRPLMRMREFSQLCPSEPGTLLDRLRHVVGLVTGAGMSDNANTAVLPLGDGRVVCLADVTKSSVLVDPE TLETVGKLRYADRLWCPVQCTHPVVTTTTTTTTRAAAAAEVLMLHPDFARRGYLVARMMAAGGTGSNDRREVVGRVRCRGGTTPAWVHSFAVTAKYIVVPEMPLRY SVACLLMSELTPFYIMDWLPHSGSYMHVICRSTGNTVASVEVPPFVAFHFINAYEENGDDDDGVRPNAIIADCCEYYADPAIIQALALHRLRSPETAKDFPDSRVA RFRIPLDGSAAMGELETVLDPEEHGRGVELSTINPDYVGKEYRYLYACTARRPCNFFNALTKMDLVEKETTSWHEEGTVPSEPFFVARPGATNEDDGVVISTASTM DGDGYVLLLDAATFKEIARLRLPYGLPFGF HGCWIPDNN
SbCCD8d-like	MFRDGLKPTNSCRCRCIRSHRAPADHALPCFTPPNAIKVPPSPGLKKQALILQGISQALKSVSSNLLERFIDRAYRFSEQPSLNEGNFRPVNEIDEAVLLNSLDGQ VPGDFPEGVYIRNGPNPLNPTQTIADSIFGSTSYTYYEGHGMLHAVYFNKSNLGEWKISYRNKFGKAVKDSANTSIFEHAGRAFAVMESHLPYEININNLNTLGPY SINGAWNQPFTSHPKKIHGSGELVIMGTNTEKPYYVLGVISSDGESIVHKVDLKFGDGRLIHDIGVTKRYNIIMDYPLRFGISRTFLQKPFIENDLNGKSRIGVMP

	RFGDAESIIWFDVKNHCSYHLFNCFEDGNEVVIRGCRVLASLIPSGHEDSEDFDPSLDGTLFSRPYEWRLNLENSIVCEDYITSEKIAMDFPVINDKFIGIQNKYG YAQVADSLATSKTGLFKFKMIAKLHFNMPDKENKELISVEYHTLKEKQFCSGVQFVAKKNGIDEDDGWVVTYVHDEGTNVSQVHIIDAKRFSEEPVAKITLPQRVP YGFHGNFFYTSNQR

Table S2. Protein Sequences of all carotenoid dioxygenases found in rice (*Os*), maize (*Zm*) and sorghum (*Sb*). The sequences were either obtained by manual curation of the available genomic sequences (maize) and/or database mining (rice and sorghum). *Oryza sativa* sequences were obtained from the rice genome browser (http://rice.plantbiology.msu.edu/cgi-bin/gbrowse/rice/), where you can use listed locus numbers in Table 1 to pull out corresponding nucleotide sequence information. *Sorghum bicolor* sequences were obtained specifically from Phytozome using rice locus number as a bait in its search finder (http://www.phytozome.org/search.php?show=text). Use the locus number listed in Table 1 as bait to pull out the corresponding nucleotide sequence information of all paralogous and orthologous sequences. Additionally you can also obtain all other sequences used in the present work by selecting different nodes on an evolutionary tree.

Gene	No.	Sequence	Gen Bank ID.
NCED1	1652	GCCCAGCTCGTAGCTTAACA	AC201886
	1653	CGAGCAAGTAACAGCAACCA	
NCED2	2188	ACGGCTACATCCTGTCCCTC	AC199036
	1881	AGAACAACCAAGGAATCATCAGG	
NCED3a	2237	CGATCACGAACTCGACCAAC	AC212820
	2060	CCGGCGTCTGCCTCAAA	
NCED3b	2055	CGATCACGAACTCGACCACC	AC205109
	2081	GCATGCAAATATACATATGTGCGG	
NCED9	2185	GAGAGATTATTAGTAGCAGTAGGGAGAG	AC190614
	2018	GCAACCGATCCTAGACACCC	
CCD1	2064	CTGGAGAAGAAGATGACGGCTAT	DQ100347
	2065	AGGCATGGAATCCATAAGGAAC	
CCD4a	1816	AAGCACCGAACACTCGTCCA	AC190588
	1817	ACTCTTTTATGGGTTCTGCTACATTT	
CCD4b	1818	TCCCCTACGGCTTCCACG	AC194862
	1819	ATCCAGCGGCGTGTTTCTC	
CCD7	1836	TGACGCCACAGACATCCATT	AC211432
	1837	TGGGACCGACGAGCAGAA	
CCD8a	1834	TGCTGCTCACATCTCCCACA	AC185113
	1835	CGTGTAATTGCTACAGCCACATT	
CCD8b	2321	GAAAGCTATGCGAGAATCGG	AC198395
	2322	GTATTATGGAGTCCGGCGAA	
PDS	933	GAAATCATCGATGCAACTATGGAA	L39266
	934	CTTCGATAGGTGACCTTTGGA	
Actin	1134	CGATTGAGCATGGCATTGTCA	J01238
	1135	CCCACTAGCGTACAACGAA	

Table S3. Primers used in the study

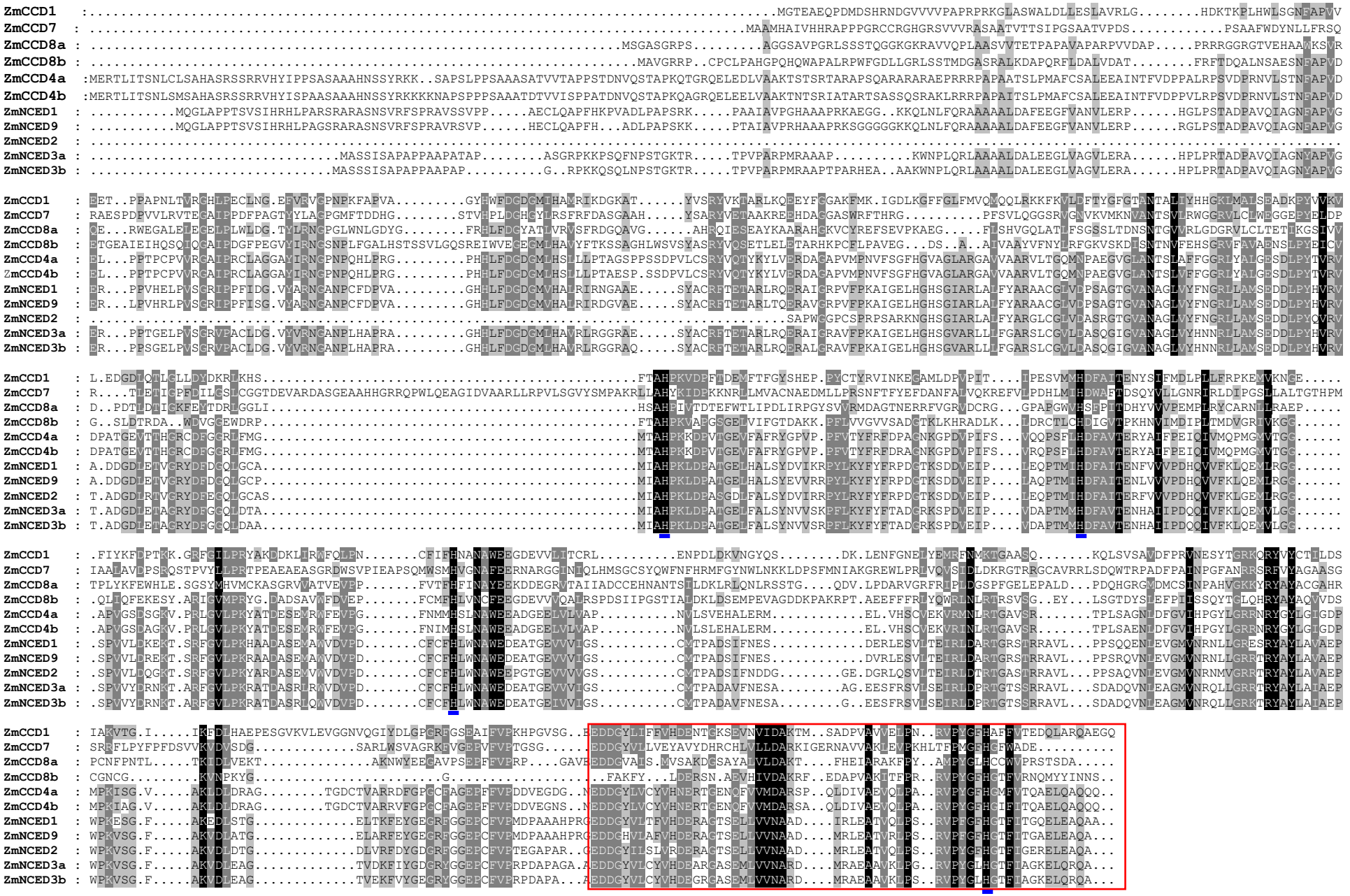

Figure S1. Aligned *Zea mays* cleavage dioxygenases sequences. Conserved histidine motifs are underlined in blue; . conserved C-terminal signature is boxed in red (Auldridge et al., 2006). Table 1 lists accession numbers.

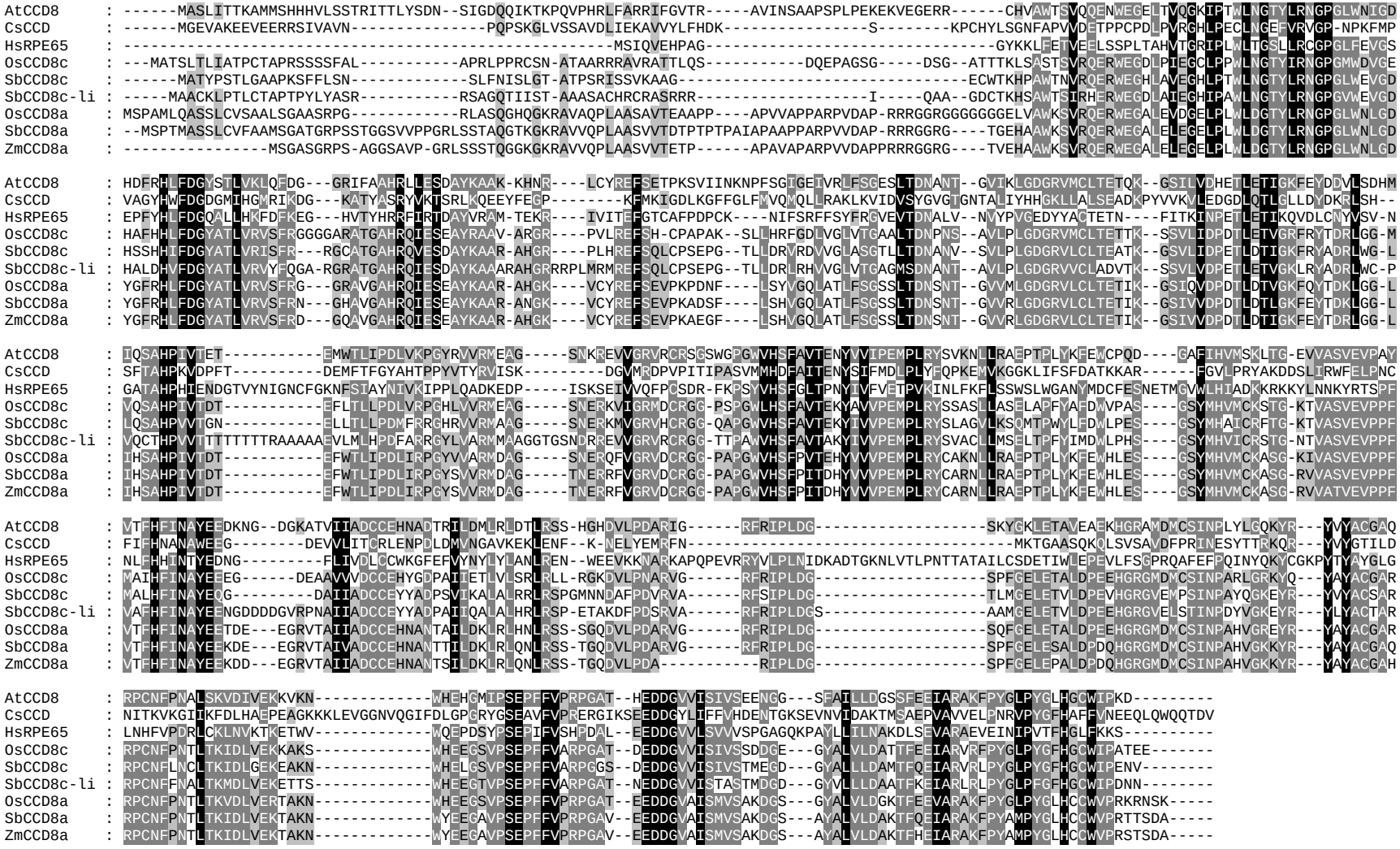

Figure S2. Protein sequence alignment of CCD8a carotenoid cleavage dioxygenase sub-family.

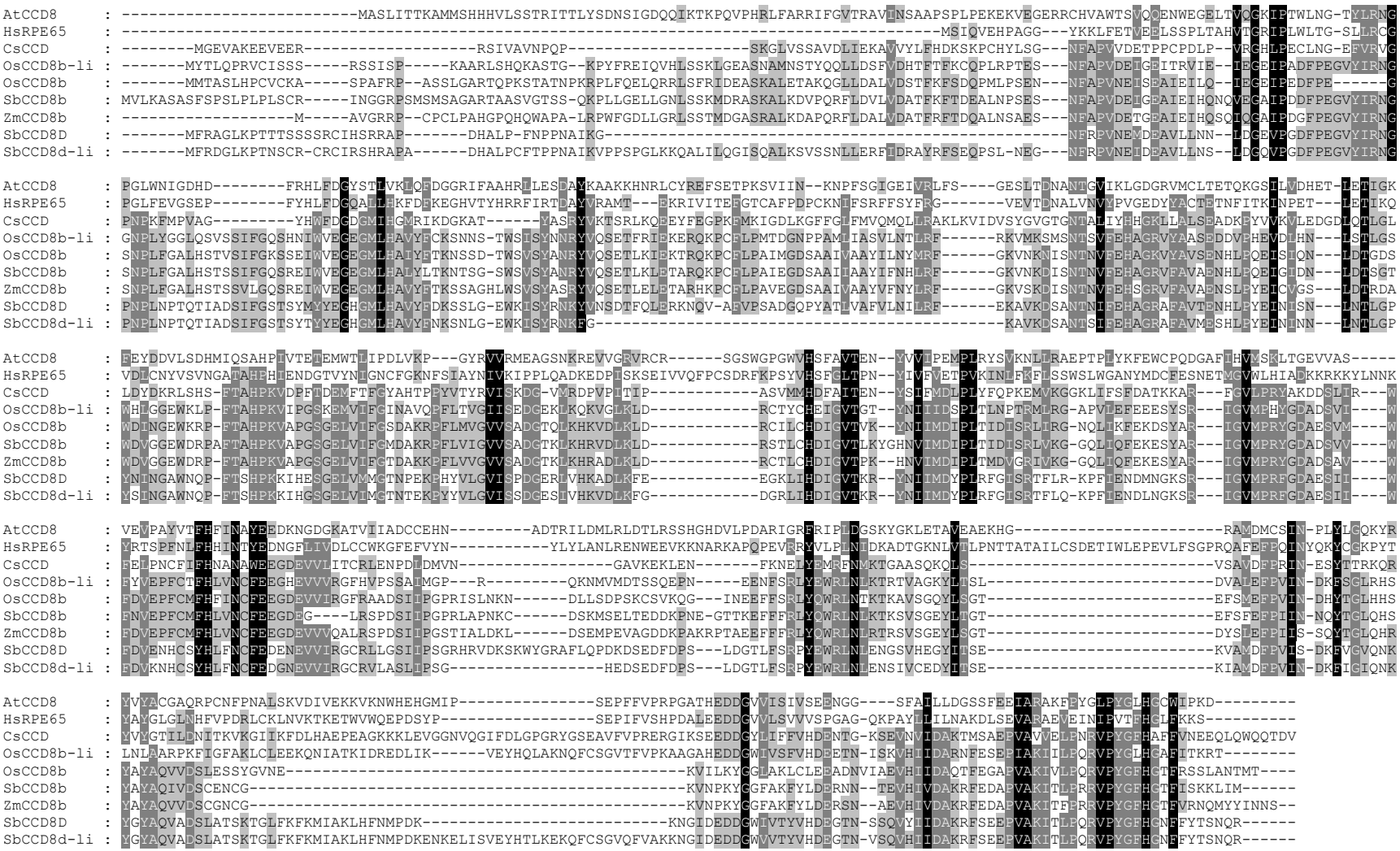

Figure S3. Protein sequence alignment of CCD8b carotenoid cleavage dioxygenase sub-family.