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**Supporting information for article:**

**Crystal structure of phosphoribulokinase from *Synechococcus sp.*  
strain PCC 6301**

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		$\alpha 2$		$\eta 2$	$\alpha 3$	$\beta C$																																																		
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1	Syn_PCC6301	53	KE	..	A	..	GVTALDP	RANFND	LMY	EQVKALK	KNGETI	MKPIY	YNH	.....																																										
	Syn_PCC6803	54	KA	..	A	..	GVTALDP	RANFND	LMY	EIQIKTLK	SGQSI	MKPIY	YNH	.....																																										
	T_elongatus_BP1	54	KE	..	M	..	GITALDP	RANFND	LMY	EIQIKALK	KNGESI	MKPIY	YNH	.....																																										
	Nostoc_PCC7524	54	KE	..	T	..	GITALDP	RANFND	LMY	EIQIKALK	KEGQAI	IN	KPIY	YNH	.....																																									
	S_oleracea	70	KV	..	E	..	KVTALDP	KANFDF	LMY	EQVKALK	KEGKAV	D	KPIY	YNH	.....																																									
	O_sativa	70	KE	..	K	..	GVTALDP	RANFND	LMY	EQVKAIK	KEGKAI	E	KPIY	YNH	.....																																									
	S_moellendorffii	65	KE	..	K	..	GVTALDP	KANFND	LMY	EQVKALK	KEGKAV	Q	KPIY	YNH	.....																																									
	C_reinhardtii	68	KV	..	K	..	GVTALDP	EAQNFD	LMY	NQVKALK	KEGKSV	D	KPIY	YNH	.....																																									
	V_carteri	73	KV	..	K	..	GVTALAP	EAQNFD	LMY	NQVKALK	KEGKAV	D	KPIY	YNH	.....																																									
	B_prasinus	68	KE	..	S	..	GLTALNL	KEQNFD	LMH	EQVKALK	KEGKTV	Q	KPIY	YNH	.....																																									
	P_umbilicalis	65	AA	..	A	..	KVTALDP	VANNFE	LMY	QMCKALK	KEGKSV	D	KPIY	YNH	.....																																									
	G_sulfuraria	65	AE	..	K	..	KVTALNP	EANNFE	LMY	QQIAALK	KEGYDI	M	KPIY	YNH	.....																																									
	B_natans	65	AD	..	T	..	GISALDV	RANFAL	LMAD	QLKALK	KQGRAI	K	KPIY	YNH	.....																																									
	C_merolae	64	KE	..	D	..	NITALDE	NCQNF	DLMA	EQLEALK	KNGFDI	M	KPIY	YNH	.....																																									
	G_chorda	65	RE	..	A	..	KVTALDE	RANFND	LMAS	SIQI	QALK	KEGKSI	M	KPIY	YNH	.....																																								
	P_purpureum	65	KV	..	A	..	NVTALDE	KANFNT	LMAA	QVKALK	KEGKAI	Y	KPIY	YNH	.....																																									
2	L_chlorophorum	76	KV	..	S	..	KVTALDP	EAQNFD	LMY	EIAALK	RGETI	K	KPIY	YNH	.....																																									
	E_gracilis	78	KV	..	T	..	GLTALDQ	RENDFD	LMFE	QMS	SLK	RGETI	IA	KPIY	YNH	.....																																								
	P_tricornutum	77	KV	..	T	..	MRTALDP	EENFND	LMY	EQVKALK	DGKTV	E	KPIY	YNH	.....																																									
	T_pseudonana	76	KV	..	S	..	GLTALNP	EAQNFD	LMY	EHVKALK	KEGKTI	M	KPIY	YNH	.....																																									
	G_theta	68	KK	..	T	..	GLTALDP	RENDFD	LMY	EQVKALK	KEGKTI	M	KPIY	YNH	.....																																									
	L_polyedra	65	KA	..	T	..	GLTALDA	KENDFAL	MVQ	IEALK	QKAVY	K	KPIY	YNH	.....																																									
	E_huxleyi	68	KS	N	P	E	W	P	D	..	GITALHE	ACQND	K	M	A	D	V	T	D	L	K	A	G	K	A	V	E	M	K	P	I	Y	N	H	.....																					
3	A_profundus	58	ER	..	L	..	GITPLHP	SANNLK	LVETH	LYLL	KK	KEKI	K	K	P	T	Y	N	H	.....																																				
	H_hungatei	72	SE	..	M	..	GITPLH	TANNLK	LLEN	LM	DL	K	A	G	R	T	I	Q	K	P	V	Y	L	H	.....																															
	M_paulustris	79	KV	..	R	..	HITPLNP	EANRLD	QLEH	DL	VE	L	T	E	G	R	T	I	K	P	V	Y	N	H	.....																															
	M_thermophilus	62	RK	..	L	..	GITPLAP	EANRFD	LLEH	LAAL	KEGKTI	Q	K	P	V	Y	N	H	.....																																					
4	R_sphaeroides	53	KA	..	E	L	D	R	R	Y	A	A	G	D	A	T	F	S	H	F	S	Y	E	A	N	L	K	E	L	E	R	V	F	R	E	Y	G	E	T	G	G	R	R	T	Y	V	H	D	D	A	E	A	A	R	.....	
	R_rubrum	53	KI	..	A	M	A	E	A	Q	K	A	G	N	A	N	F	S	H	F	G	P	E	A	N	L	F	E	E	L	T	L	F	R	T	Y	G	E	T	G	G	R	R	L	Y	L	H	N	D	E	A	A	P	.....		
	P_luminescens	53	DA	..	A	I	R	K	A	E	Q	G	R	H	I	S	Y	F	G	P	E	A	N	D	F	G	M	L	E	K	T	M	I	D	Y	G	E	T	G	E	G	R	R	K	Y	L	H	T	Y	D	A	V	P	.....		
	Syn_WH7803	53	KK	..	A	M	A	E	A	L	S	K	G	E	N	F	S	H	F	G	P	E	A	N	L	F	D	K	L	E	E	L	F	R	V	Y	G	E	T	G	G	Q	K	R	Y	L	H	S	P	E	E	A	A	E	.....	
	P_chromatophora	53	KQ	..	A	M	E	K	A	L	S	I	G	E	N	F	S	H	F	G	P	E	A	N	L	F	D	K	L	E	E	L	F	K	V	Y	G	E	T	G	G	E	K	R	L	I	D	L	P	V	Y	S	Y	.....		
	H_crunogenus	53	KE	..	K	V	A	A	S	K	A	N	G	G	P	V	L	T	H	F	S	E	K	A	N	F	G	E	L	E	A	L	F	K	E	Y	K	E	N	G	T	G	K	R	Y	Y	I	H	S	D	E	E	A	A	E	.....
5	D_swuensis	52	TR	..	L	..	K	T	N	Y	D	H	P	A	A	F	D	W	E	L	L	R	A	H	L	D	A	L	L	A	G	V	P	I	D	M	P	E	V	F	Y	.....														
	E_coli	60	ER	..	V	..	K	T	N	Y	D	H	P	S	A	M	D	H	S	L	L	E	H	L	Q	A	L	K	R	G	L	A	I	D	L	P	V	Y	S	Y	.....															
	H_volcanii	52	ER	..	E	..	Q	V	N	Y	D	H	P	S	A	F	E	W	D	L	L	Y	E	Q	L	S	E	L	M	E	G	R	A	V	E	M	P	Q	V	D	F	.....														
	T_thermophilus	53	ER	..	L	..	R	V	N	Y	D	H	P	D	A	F	D	L	A	L	Y	L	E	H	A	Q	A	L	R	G	L	P	V	E	M	P	V	D	F	.....																

			$\beta D$	$\beta E$	$\alpha 4$	$\beta F$																																																	
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1	Syn_PCC6301	91	ETGL	IDDP	EKI	EPNR	IIVIEGLHPLYDE	.....	RVRELLD	DFS	SVY	.....																																											
	Syn_PCC6803	92	ETGL	LDDP	EKV	EPNK	VVIVIEGLHPLYDE	.....	RVRELVDF	GVY	.....																																												
	T_elongatus_BP1	92	ETGT	IDDP	EKV	DPNH	VIVIEGLHPLYDE	.....	RVRSLLD	DFS	SVY	.....																																											
	Nostoc_PCC7524	92	ETGM	IDDP	EIV	EPNH	IIVVEGLHPLYDE	.....	RVRSLLD	DFS	SVY	.....																																											
	S_oleracea	108	VSGL	LDDP	ELI	QPPK	ILVIEGLHPMYDA	.....	RVRELLD	DFS	SIY	.....																																											
	O_sativa	108	VTGL	LDDP	ELI	QPPK	IFVIEGLHPMFDE	.....	RVRDLLD	DFS	SIY	.....																																											
	S_moellendorffii	103	VSGL	LDDP	ELI	QPPK	ILVIEGLHPMFDS	.....	RVRELLD	DFS	SIY	.....																																											
	C_reinhardtii	106	VSGL	IDAP	EKI	ESPP	ILVIEGLHPFYDK	.....	RVRELLD	DFS	KIY	.....																																											
	V_carteri	111	VTGL	IDAP	EKI	DSPN	ILVIEGLHPFFDK	.....	RVADLLD	DFS	KIY	.....																																											
	B_prasinus	106	VTGV	FDP	AEI	VSPK	VLLIEGLHPFADD	.....	RVRNFD	DFS	KIY	.....																																											
	P_umbilicalis	103	ETGR	IDDP	ELI	NPNH	VIVIEGLHPMYDA	.....	RVRELLD	DFS	VIY	.....																																											
	G_sulfuraria	103	QTGL	IDDP	ELI	QPNH	IIVIEGLHPWYDA	.....	RMKQLD	DFS	TVY	.....																																											
	B_natans	103	DTGA	IDP	VEI	HPNH	IIVIEGLHPMLDK	.....	DVIESL	DFS	TFY	.....																																											
	C_merolae	102	ETGR	IDP	ELV	SPNH	IIVVEGLHPMYDE	.....	RVRKLLD	DFS	VIY	.....																																											
	G_chorda	103	ETGE	IDDP	ELV	EPNH	LVVIEGLHPMYDE	.....	RVRDVLD	DFS	TVY	.....																																											
	P_purpureum	103	DTGE	HDP	SEI	EPNH	LVVIEGLHPMYDP	.....	RVAE	LDL	SVY	.....																																											
2	L_chlorophorum	114	VNGT	LDE	PEI	KPTP	IVIEGLHPFVDE	.....	RVRK	LID	SIY	.....																																											
	E_gracilis	116	VNGT	LDTP	EEL	APAS	IMIIEGLHPLDD	.....	RVAG	LLD	SIY	.....																																											
	P_tricornutum	115	VNGT	LDTP	EEL	EPTP	IIIFEGHHPMDK	.....	RVLD	LLD	SIY	.....																																											
	T_pseudonana	114	VNGT	LDTP	EEL	EPTP	VIIIEGLHPFVDE	.....	RVRE	LID	SIY	.....																																											
	G_theta	106	VNGT	LDE	PEI	TPTP	IIIFEGHHPFYDK	.....	RV	EEL	MD	FS	Y	.....																																									
	L_polyedra	103	DTGN	KDP	PEI	EPNK	VMVFEGHHPFYDK	.....	KARD	Q	LD	L	GI	Y	.....																																								
	E_huxleyi	111	ITGE	LDP	EPV	QPTP	IVIEGLHPMHDE	.....	RVNE	ALD	L	T	I	Y	.....																																								
3	A_profundus	96	KTGT	FGE	WED	ESTP	IVIEGLHHTLYD	.....	GIRD	Y	I	D	F	K	I	F	.....																																						
	H_hungatei	110	DHGT	FGE	PEL	SPTK	FIIIEGLHPHYATK	.....	SLRAL	Y	D	Y	T	I	F	.....																																							
	M_paulustris	117	ANGR	FAPP	IRF	TPGK	ILILEGLHTFFTP	.....	ALRE	H	L	D	F	T	L	F	.....																																						
	M_thermophilus	100	NTGR	FDP	PVP	SPTK	ILILEGLHPFITP	.....	RLR	G	L	I	D	F	K	L	Y	.....																																					
4	R_sphaeroides	108	TGV	APGN	FTD	WRD	FDSD	SHLLFYEGHGGAVVNS	.....	EVN	I	A	G	L	A	D	L	K	I	G	.....																																		
	R_rubrum	108	FAQ	EPGT	FTP	WED	PE	SDLLFYEGHGGAVVTD	.....	TVD	V	A	Q	H	A	D	L	K	I	G	.....																																		
	P_luminescens	107	YNQL	P	GT	FTP	WESL	PKQTDVLFYEGHGGVVT	.....	QHN	V	A	S	H	V	D	L	L	V	G	.....																																		
	Syn_WH7803	107	HNAR	L	G	V	ELDP	Q	FTP	WED	IP	S	Q	T	D	L	L	F	Y	E	G	H	G	V	Q	E	.....	SYD	V	A	A	L	A	D	L	L	V	G	.....																
	P_chromatophora	107	HNAR	L	S	T	N	L	K	P	G	Q	FTP	W	E	A	I	S	K	N	T	D	L	L	F	Y	E	G	H	G	V	E	S	K	.....	NHD	V	S	N	V	D	L	L	V	G	.....									
	H_crunogenus	108	HNAR	L	G	T	N	F	S	S	G	E	FTP	W	E	P	I	P	E	G	T	D	V	L	F	Y	E	G	H	G	M	V	K	R	M	D	H	G	P	K	E	G	M	H	N	V	A	Q	V	D	L	G	I	G	.....
5	D_swuensis	90	TQ	H	T	R	S	A	R	T	T	V	L	P	S	G	V	V	L	E	G	F	F	A	L	Y	D	E	.....	E	L	R	A	R	M	H	L	K	S	I	F	.....													
	E_coli	98	VE	H	T	R	M	K	E	T	T	V	E	P	K	K	V	I	L	E	G	I	L	L	L	T	D	A	.....	R	L	R	D	L	N	F	S	I	F	.....															
	H_volcanii	90	E	H	N	R	K	S	E	R	E	T	V	E	P	T	D	V	I	L	E	G	I	L	A	L	Y	D	E	.....	D	V	N	E	M	L	D	L	R	L	Y	.....													
	T_thermophilus	91	RAY	T	R	S	P	R	R	T	P	V	R	P	A	P	V	V	I	L	E	G	I	L	V	L	Y	P	K	.....	E	L	R	D	L	M	D	L	K	V	F	.....													



		βJ →		βK →		α7	
		..		→		.. . . . .	
1	Syn_PCC6301	227	T	P	C	G	R
	Syn_PCC6803	227	R	P	C	G	R
	T_elongatus_BP1	228	I	P	C	G	R
	Nostoc_PCC7524	228	T	P	C	G	R
	S_oleracea	244	I	P	C	G	R
	O_sativa	244	V	P	C	G	R
	S_moellendorffii	239	I	P	C	G	R
	C_reinhardtii	241	I	P	C	G	R
	V_carteri	246	I	P	C	G	R
	B_prasinus	242	I	P	C	G	R
	P_umbilicalis	238	V	P	C	G	K
	G_sulfuraria	239	I	P	C	G	R
	B_natans	241	D	P	C	A	G
	C_merolae	238	I	P	C	G	R
	G_chorda	239	V	P	C	G	R
	P_purpureum	239	V	P	C	G	R
2	L_chlorophorum	249	I	P	C	G	T
	E_gracilis	255	K	P	C	G	D
	P_tricornutum	249	T	P	A	P	T
	T_pseudonana	248	A	P	S	A	D
	G_theta	240	V	P	P	R	S
	L_polyedra	227	L	T	L	T	S
	E_huxleyi	246	V	P	N	G	D
3	A_profundus	233	S	D			
	H_hungatei	242	C	D			
	M_paulustris	249	F	S			
	M_thermophilus	232	F	P			
4	R_sphaeroides	247					
	R_rubrum	246					
	P_luminescens	246					
	Syn_WH7803	256					
	P_chromatophora	256					
	H_crunogenus	264					
5	D_swuensis						
	E_coli						
	H_volcanii	205					
	T_thermophilus						

		α8		α9	
		.. . . . .		.. . . . .	
1	Syn_PCC6301	276	L	S	K
	Syn_PCC6803	276	L	S	K
	T_elongatus_BP1	277	L	S	N
	Nostoc_PCC7524	277	L	S	N
	S_oleracea	293	L	S	N
	O_sativa	293	L	S	N
	S_moellendorffii	288	L	S	N
	C_reinhardtii	290	L	S	N
	V_carteri	295	L	S	N
	B_prasinus	291	L	S	N
	P_umbilicalis	287	L	N	N
	G_sulfuraria	288	L	N	N
	B_natans	292	L	S	N
	C_merolae	287	L	S	N
	G_chorda	288	I	E	R
	P_purpureum	288	L	N	N
2	L_chlorophorum				
	E_gracilis	304	L	H	N
	P_tricornutum	298	L	S	N
	T_pseudonana	297	L	G	N
	G_theta	291	F	A	S
	L_polyedra	275	L	E	G
	E_huxleyi	295	I	S	A
3	A_profundus	284	D	G	E
	H_hungatei	293	I	S	P
	M_paulustris	300	V	R	P
	M_thermophilus	283	V	Q	P
4	R_sphaeroides	276			
	R_rubrum	275			
	P_luminescens	275			
	Syn_WH7803	285			
	P_chromatophora	285			
	H_crunogenus	293			
5	D_swuensis				
	E_coli				
	H_volcanii	218			
	T_thermophilus	206			

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..Q
1 Syn_PCC6301 323 ..TSQ.A.....A.P.....VA.ASV
  Syn_PCC6803 323 ..TAE.A.....K.....VP.ASV
  T_elongatus_BP1 324 ..TSR.D.....A.A.....TV.TNR
  Nostoc_PCC7524 324 ..TAK.E.....A.K.....LA.VQV
  S_oleracea 340 ..VAS.R.....STATATA.AKA
  O_sativa 340 ..IAE.R.....AGAPTEA.AKV
  S_moellendorffii 335 ..TSK.Q.....GSP...VGAAAAAT.SKV
  C_reinhardtii 337 ..VKK.D.....V.VPV
  V_carteri 342 ..VKK.D.....V.VPA
  E_prasinus 338 ..SET.E.....V.VAK
  P_umbilicalis 334 ..TGR.K.....V.L.....P.RAA
  G_sulfuraria 335 ..TGK.S.....I.A.....P.VLV
  E_natans 339 ..TGR.T.....I.Q...IPKWGLFLDDY
  C_merolae 334 ..TGR.K.....V.D.....PVVRS
  G_chorda 335 ..TGK.K.....V.S.....V.SSS
  P_purpureum 335 ..TGR.K.....L.....SVN
2 L_chlorophorum
  E_gracilis 351 ..TG.....EKA
  P_tricornutum 345 ..TAA.AKAKAGV.....SA.AAA
  T_pseudonana 344 ..SAAAKLAATKE.....TA.ASA
  G_theta 338 ..AKV.K.....V.....PA.QAN
  L_polyedra 322 ..TG.....GK
  E_huxleyi 342 .....RK
3 A_profundus 316 .....LRL
  H_hungatei 330 .....LDQ
  M_paulustris 338 HQ.....D.HNK
  M_thermophilus 321 ESTGR.K.....V.TAAASGGCGCG.DRR
4 R_sphaeroides 288 .....KVA
  R_rubrum 290 .....LGR
  P_luminescens 287 .....KIS
  Syn_WH7803 298 .....KLG
  P_chromatophora 298 .....RQF
  H_crunogenus 311 .....LNG
5 D_swuensis 203 .....TI
  E_coli 211 .....FFE
  H_volcanii 229 .....SGN
  T_thermophilus 209 .....GAA

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**Figure S1** Sequence alignment for the classification of PRK sequences. The amino acid alignment of PRK and uridine kinases from Fig. 1 was rendered using ESPript (Gouet *et al.*, 1999). Similar residues are shown in red and identical residues in white on a red background. Blue frames indicate homologous regions. Species abbreviations and NCBI sequence identifier information are as follows: abbreviation, species genus (NCBI code). Uridine kinase: *E. coli*, *Escherichia coli* (WP\_097516444.1); *H. volcanii*, *Haloferax volcanii* (WP\_004043040.1); *T. thermophilus*, *Thermus thermophilus* (WP\_011172663.1); *D. swuensis*, *Deinococcus swuensis* (WP\_039685329.1). Phosphoribulokinase: *H. crunogenus*, *Hydrogenovibrio crunogenus* (WP\_011369436.1); *P. chromatophora*, *Paulinella chromatophora* (YP\_002048771.1); *Syn* sp. WH 7803, *Synechococcus* sp. WH 7803 (WP\_011933059.1); *P. luminescens*, *Photorhabdus luminescens* (WP\_036780244.1); *R. rubrum*, *Rhodospirillum rubrum* (WP\_011390157.1); *R. sphaeroides*, *Rhodobacter sphaeroides* (P12033.2); *M. thermophilus*, *Methanoculleus thermophilus* (WP\_066956607.1); *M. palustris*, *Methanosphaerula palustris* (WP\_012617646.1); *M. hungatei*, *Methanospirillum hungatei* (WP\_011447825.1); *A. profundus*, *Archaeoglobus profundus* (WP\_012940929.1); *L. polyedra*, *Lingulodinium polyedra* (AAX13961.1); *E. huxleyi*, *Emiliania huxleyi* CCMP1516 (XP\_005767208.1); *G. theta*, *Guillardia theta* CCMP2712 (XP\_005827680.1); *T. pseudonana*, *Thalassiosira pseudonana* CCMP1335 (XP\_002289281.1); *P. tricornutum*, *Phaeodactylum tricornutum* CCAP 1055/1 (XP\_002186456.1); *E. gracilis*, *Euglena gracilis* (AAX13964.1); *L. chlorophorum*, *Lepidodinium chlorophorum* (CCC15103.1); *S. oleracea*, *Spinacia oleracea* (XP\_021851648.1); *O. sativa*, *Oryza sativa* Japonica Group (XP\_015625719.1); *S. moellendorffii*, *Selaginella moellendorffii* (XP\_002986864.1); *V. carteri*, *Volvox carteri* f. *nagariensis* (XP\_002949322.1); *C. reinhardtii*, *Chlamydomonas reinhardtii* (XP\_001694038.1); *B. prasinus*, *Bathycoccus prasinus* (XP\_007512393.1); *Syn* sp. PCC 6301, *Synechococcus elongatus* sp. PCC 6301 (WP\_011242879.1); *Syn* sp. PCC 6803, *Synechocystis* sp. PCC 6803 (WP\_010873078.1); *T. elongatus* BP-1, *Thermosynechococcus elongatus* BP-1 (WP\_011057751.1); *Nostoc* sp. PCC 7524 (WP\_015137356.1); *P. umbilicalis*, *Porphyra umbilicalis* (OSX70232.1); *G. sulphuraria*, *Galdieria sulphuraria* (XP\_005707300.1); *B. natans*, *Bigelowiella natans* (AAP79209.1); *C. merolae*, *Cyanidioschyzon merolae* strain 10D (XP\_005535773.1); *G. chorda*, *Gracilariopsis chorda* (PXF44800.1); *P. purpureum*, *Porphyridium purpureum* (extracted from genome).



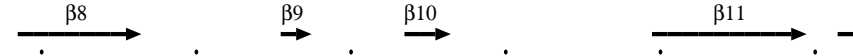





Synechococcus_PCC6301	88	YNHETGLIDPPPEKLEPNRILVIVEGLHPLYDERVRELLDFSVYLDIDDEVKIAWKI
Nostoc_PCC7120	89	YNHETGLIDPPPEIVKPNHIVVVEGLHPLYDERVRSLLDFSVYFDISDEVKIAWKI
Thermosynechococcus_elongatus	89	YNHETGTIDPPPEKVDPNHIVIVEGLHPLYDERVRSLLDFSVYLDISDDVKIAWKI
Zea_mays	167	YNHVTGLLDPPPELITPPPKIFVIVEGLHPLMFDERVRDLDLDFSVIYLDISDEVKFAWKI
Arabidopsis_thaliana	148	YNHVTGLLDPPPELIQPPKILVIVEGLHPLMFDERVRDLDLDFSVIYLDISDEVKFAWKI
Selaginella_moellendorffii	182	YNHVSGLLDPPPELIQPPKILVIVEGLHPLMFDSEVRRELLDFSVIYLDISDAVKFAWKI
Physcomitrella_patens	174	YNHVTGLLDAPPEITHPPKILVIVEGLHPLMYDERVRELLDFSVIYLDISDDVKFAWKI
Tetraselmis_GSL018	147	YNHVSGLLDPPPEIKAPPEVLVIVEGLHPLFYDERVRDLDVDFSVIYLDISDDVKFAWKI
Auxenochlorella_protothecoides	110	YNHVTGALDPPPEITPPPKILVIVEGLHPLFFDDRVRNDLIDFRIYLDISDATKFAWKI
Volvox_carteri	135	YNHVTGLIDAPEKIDSPNILLVIVEGLHPLFFDKRVALLDLDFKIIYLDISDDIKFAWKI
Chlamydomonas_reinhardtii	134	YNHVTGVLDPPEKIESPEVLVIVEGLHPLFYDKRVAELLDLDFKIIYLDISDDIKFAWKI
Micromonas_pusilla	133	YNHVTGVVDFPAEKIESPDIILLVIVEGLHPLFADDERVRDMFDFKIIYLDISDDVKFAWKI
Ostreococcus_tauri	139	YNHVTGVVDFPAEKIESPEVLVIVEGLHPLFADTRVRDMFDFKIIYLDISDDVKFAWKI
Ostreococcus_lucimarinus	139	YNHVTGVVDFPAEKIESPEVLVIVEGLHPLFADTRVRDMFDFKIIYLDISDDVKFAWKI
Ectocarpus_siliculosus	186	YNHVNGTLDTPPEIKPTPIVIVEGLHPLFVDDKRVRDLDLDFTIYLDISDEVKFAWKI
Galdieria_sulphuraria	204	YNHQTGLIDPPPELIQPNHILVIVEGLHPLWYDARMKQLLDLFTVYLDISDEVKFAWKI



Synechococcus_PCC6301	143	QRDMAERGHSYEDVLASTIARRKPDFKAYIEPQRGHADIVIRVMPTQLIPNITERRK
Nostoc_PCC7120	144	QRDMAERGHRYEDVLAATNSRKPPDFQKYIEPQREFADVVLQVLPNTLIKDDTERK
Thermosynechococcus_elongatus	144	KRDMAERGHSYEDVIASTNARRPDFMAYIDPQKQYADVVLQILPSQLAKEEKVGN
Zea_mays	222	QRDMAERGHSLSESIKASTIARRKPDFDAYIDPQKQYADAVIEVLPQTQLIPNDEGK
Arabidopsis_thaliana	203	QRDMAERGHSLSESIKASTIARRKPDFDAFIDPQKQYADAVIEVLPPTLLIPDDNEGK
Selaginella_moellendorffii	237	QRDMAERGHSLSESIKASTIARRKPDFDAYIDTQKQYADVVIQVLPQTQLIPDDNEGK
Physcomitrella_patens	229	QRDMAERGHSLSESIKASTIARRKPDFDAYIDPQKQYADVVIQVLPQTQLIPDDNEGK
Tetraselmis_GSL018	202	QRDMAERGHSLSESIKASTIARRKPDFDAYIDPQKQYADAVIEVLPPTLLIPDDNEGK
Auxenochlorella_protothecoides	165	QRDMERGHSLSESIKASTIARRKPDFDAYIDPQKAKADVVIQVLPPTDLVPDEKEGK
Volvox_carteri	190	QRDMAERGHSLQAIKSSIARRKPDFDAYIDPQKDDADMIQVLPQTQLVPDD.KGQ
Chlamydomonas_reinhardtii	189	QRDMAERGHSLSESIKASTIARRKPDFDAYIDPQKDDADMIQVLPQTQLVPDD.KGQ
Micromonas_pusilla	188	QRDMAERGHSLSESIKASTIARRKPDFDFVDPQKQYSDVVIQVLPQTQLIPDDNEGK
Ostreococcus_tauri	194	QRDMAERGHSLSESIKASTIARRKPDFDAFVDPQKEHADVVIQVLPQTQLIPDDNEGK
Ostreococcus_lucimarinus	194	QRDMAERGHSLSESIKASTIARRKPDFDAFVDPQKEFSDVVIQVLPQTQLIPDDNEGK
Ectocarpus_siliculosus	241	QRDMMERGHSLSESIQASTIARRKPDFDAFIAPQRSADVVIQVLPQTQLIPGDTTEGK
Galdieria_sulphuraria	259	QRDMAERGHKLENILASTIARRKPDFQYIDPQKQDAVAVIQVLPPTRLIPDDTERK



Synechococcus_PCC6301	198	VLRVQLIQREQRDEGEFEPAYLFDDEGSTIQWTPCGRKLTCSYPGIRLAYGPDITYYGH
Nostoc_PCC7120	199	VLRVRMLQREQEGEPEPAYLFDDEGSTINWTPCGRKLTCSYPMQLY YGSDVYYGR
Thermosynechococcus_elongatus	199	ILRVRMLQREQEIPGEFEPVYLFDEGSTITWIPCGRKLTCSTYPIRSLAYGPDITYYGH
Zea_mays	277	VLRVKLIMKEGVDFENPVLFDDEGSTISWVPCGRKLTCSYPGIKFA YGPDITYYGH
Arabidopsis_thaliana	258	VLRVRLIMKEGVYFSPVYLFDEGSTISWIPCGRKLTCSTYPIKFN YEPDSYFDH
Selaginella_moellendorffii	292	VLRVRMIMKEGVDFEPVYLFDEGSTISWIPCGRKLTCSTYPIKFF YGPDITYYDN
Physcomitrella_patens	284	VLRVRMVMKEGVDFEPVYLFDEGSTISWIPCGRKLTCSTYPIKFF YGPDITYYGN
Tetraselmis_GSL018	257	VLRVRLIMKEGLENDFPVLFDDEGSTISWIPCGRKLTCSTYPIKFF YGPDITYYGE
Auxenochlorella_protothecoides	220	ILRVRLIQKEGRELFSPSYLFDEGSTISWVPCGRKLTCSFPGIKLF YGPDITYYGE
Volvox_carteri	244	YLRVRLIQKEGSKMDFPVLFDDEGSTISWIPCGRKLTCSTYPIKMF YGPDITWYGO
Chlamydomonas_reinhardtii	243	YLRVRLIMKEGSKMDFPVLFDDEGSTISWIPCGRKLTCSTYPIKMF YGPDITWYGO
Micromonas_pusilla	243	ILRVRMIMKEGVENFDAPYLFDEGSTISWIPCGRKLTCSTYPIKFF YGPDITFFGE
Ostreococcus_tauri	249	ILRVRMIMKENVENFDAPYLFDEGSTISWIPCGRKLTCSTYPIKFF YGPDITYYGN
Ostreococcus_lucimarinus	249	ILRVRMIMKEGLENDFPVLFDDEGSTISWIPCGRKLTCSTYPIKFF YGPDITYYGN
Ectocarpus_siliculosus	296	ILRTRMVQKEGLDFDPAFLFDDEGSTISWVPCGRKLTCSFPGIKFAYGPDITYYDN
Galdieria_sulphuraria	314	VLRVRLIQREQEIQGFSQSVYLFDEGSTIDWIPCGRKLTCSTYPIKFFHYGPDITWYNH



Synechococcus_PCC6301	253	EVSVLEVDGQGFENLEEMIIYVEGHLSKTDTOYYGELTHLLLQHKDY PGSSNNGTGLF
Nostoc_PCC7120	254	YVSVLEVDGQGFENLEBEVIYIBTHLSNTSTKYQGELTQLLLQHREY PGSSNNGTGLF
Thermosynechococcus_elongatus	254	PVSVLEVDGQGFDELLEIYVESHLNLSNTSTKHYGEVTELLKHRDY PGSSNNGTGLF
Zea_mays	332	EVSVLEMDGQGFDRLELIYVESHLNLSNTKFFYGEVTEQMLKHADFP GSNNNGTGLF
Arabidopsis_thaliana	313	EVSVLEMDGQGFDRLELIYVESHLNLSNTKFFYGEVTEQMLKHADFP GSNNNGTGLF
Selaginella_moellendorffii	347	EVSVLEMDGQGFDELLEIYVESHLNLSNTSTKFFYGEITQOMLKHADFP GSNNNGTGLF
Physcomitrella_patens	339	EVSVLEMDGQGFDELLEIYVESHLNLSNTSTKFFYGEITQOMLKHADFP GSNNNGTGLF
Tetraselmis_GSL018	312	NVSVLEMDGQGFDELLEIYVESHLNLSNTSAKFYGEITQOMLKNSGF PGSSNNGTGLF
Auxenochlorella_protothecoides	275	DVSVLEMDGQGFDELLEIYVESHLNLSNTSTKFFYGEITQOMLKNSNF PGSSNNGTGLF
Volvox_carteri	299	EVSVLEMDGQGFDELLEIYVESHLNLSNTSAKFYGEITQOMLKNSGF PGSSNNGTGLF
Chlamydomonas_reinhardtii	298	EVSVLEMDGQGFDELLEIYVESHLNLSNTSAKFYGEITQOMLKNSGF PGSSNNGTGLF
Micromonas_pusilla	298	EVSVLEMDGQGFDELLEIYVESHLNLSNTSTKFFYGEITQOMLKNSGF PGSSNNGTGLF
Ostreococcus_tauri	304	EVTVLEMDGQGFDELLEIYVESHLNLSNTSAKFYGEITQOMLKNSGF PGSSNNGTGLF
Ostreococcus_lucimarinus	304	EVTVLEMDGQGFDELLEIYVESHLNLSNTSTKFFYGEITQOMLKNSGF PGSSNNGTGLF
Ectocarpus_siliculosus	351	EVSVLEMDGQGFENLEBEVIYVESHLNLSNTKFFYGEITQOMLKNSGF PGSSNNGTGLF
Galdieria_sulphuraria	369	DVSVLEVDGQGFDELLEIYVESHLNLSNTSTKFFYGEITQOMLKNSGF PGSSNNGTGLF

α9

000000000000000000

Synechococcus_PCC6301	308	QVL	T	GLK	M	R	A	A	Y	E	R	L	T	S	Q	A	A	P	V	A	A	S	V	.....									
Nostoc_PCC7120	309	QVL	T	GLK	M	R	A	A	Y	E	R	L	T	T	K	E	A	K	L	A	V	Q	V	.....									
Thermosynechococcus_elongatus	309	QVL	T	GLK	M	R	A	T	Y	E	R	L	T	S	R	D	A	A	T	V	T	N	R	.....									
Zea_mays	387	Q	T	I	V	G	L	K	I	R	D	L	Y	E	Q	I	V	A	E	R	A	G	A	P	A	E	A	A	K	V	...		
Arabidopsis_thaliana	368	Q	T	I	V	G	L	K	I	R	D	L	Y	E	Q	L	I	A	N	K	A	T	A	R	A	E	A	K	A	...			
Selaginella_moellendorffii	402	Q	T	I	V	G	L	K	I	R	D	V	F	E	R	I	T	S	K	Q	S	P	V	G	A	A	A	A	T	S	K	V	...
Physcomitrella_patens	394	Q	T	I	C	G	L	K	I	R	E	V	Y	E	R	I	L	E	K	Q	K	N	A	V	S	L	E	G	A	K	S	..	
Tetraselmis_GSL018	367	Q	T	I	V	G	L	K	I	R	E	V	Y	E	R	L	T	A	K	E	V	A	K	T	A	.....							
Auxenochlorella_protothecoides	330	Q	V	I	T	G	L	K	V	R	E	V	Y	E	Q	L	T	Q	R	E	V	A	R	V	.....								
Volvox_carteri	354	Q	T	I	V	G	L	K	V	R	E	V	Y	E	R	I	V	K	K	D	V	V	P	A	.....								
Chlamydomonas_reinhardtii	353	Q	T	I	V	G	L	K	V	R	E	V	Y	E	R	I	V	K	K	D	V	V	P	V	.....								
Micromonas_pusilla	353	Q	T	L	C	G	L	K	V	R	E	L	Y	E	R	I	S	E	K	E	V	V	A	A	.....								
Ostreococcus_tauri	359	Q	T	I	V	G	L	K	V	R	E	V	Y	E	R	I	S	G	K	E	V	V	A	K	A	.....							
Ostreococcus_lucimarinus	359	Q	T	I	V	G	L	K	V	R	E	V	Y	E	R	I	A	E	K	E	V	V	V	K	.....								
Ectocarpus_siliculosus	406	Q	T	L	V	A	L	K	L	R	E	V	Y	E	R	I	T	K	K	T	V	S	V	K	L	P	E	S	V	A	Q	..	
Galdieria_sulphuraria	424	Q	V	L	T	A	L	K	M	R	Q	L	Y	E	R	L	T	G	K	S	I	A	P	V	L	V	.....						

**Figure S2** Alignment of group IA PRK sequences for calculation of similarity scores. Amino acid sequences of a representative set of group IA PRK homologs were aligned using the EBI Clustal-O server (<https://www.ebi.ac.uk/Tools/msa/clustalo/>). The similarity scores were calculated with ESPript (Gouet *et al.*, 1999). Secondary structure elements for PRK from *Synechococcus* sp. PCC6301 are indicated above the sequences. Similar residues are shown in red and identical residues in white on a red background. Blue frames indicate homologous regions. The Uniprot accession codes for the sequences are: A0A0H3K6J7, *Synechococcus* sp. PCC6301; Q8YPR9, *Nostoc* sp. PCC7120; Q8DHN2, *Thermosynechococcus elongatus* BP-1; B6TYM1, *Zea mays*; P25697, *Arabidopsis thaliana*; D8SU48, *Selaginella moellendorffii*; A9RPJ4, *Physcomitrella patens*; A0A061S214, *Tetraselmis* GSL018; A0A087SM57, *Auxenochlorella protothecoides*, ; D8TRR7, *Volvox carteri*; A8IYP4, *Chlamydomonas reinhardtii*; C1MQ62, *Micromonas pusilla*; A0A090N369, *Ostreococcus tauri*; A4RW43, *Ostreococcus lucimarinus*; D8LBI0, *Ectocarpus siliculosus*; Q8GUE1, *Galdieria sulphuraria*.