

Table S8. CDSs in *P. thermopropionicum* exhibiting atypical codon usages and predicted donor organisms.

Locus tag	Annotation	Donor relative	P value*
PTH 2	COG0592 DNA polymerase sliding clamp subunit	<i>Cth</i>	6.5
PTH 57	COG1013 2-oxoacid:ferredoxin oxidoreductases beta subunit	<i>Bfr</i>	12.5
PTH 69	COG0143 methionyl-tRNA synthetase	<i>Dde</i>	18.0
PTH 74	COG0411 ABC-type transporter, ATPase component	<i>Moth</i>	10.0
PTH 90	COG0718 uncharacterized conserved protein	<i>Moth</i>	4.3
PTH 102	COG1171 threonine dehydratase	<i>Chy</i>	54.4
PTH 142	Hypothetical protein	<i>Chy</i>	9.5
PTH 144	Hypothetical protein	<i>Swol</i>	9.7
PTH 166	Hypothetical protein	<i>Sfu</i>	21.1
PTH 176	Hypothetical protein	<i>Moth</i>	10.2
PTH 177	Hypothetical protein	<i>Swol</i>	12.9
PTH 185	Hypothetical membrane protein	<i>Dde</i>	42.3
PTH 189	COG1098 predicted RNA binding protein	<i>Moth</i>	4.8
PTH 190	Hypothetical protein	<i>Dde</i>	23.3
PTH 227	Hypothetical protein	<i>Sac</i>	3.0
PTH 228	COG1104 cysteine sulfinate desulfinate	<i>Sac</i>	4.0
PTH 251	Hypothetical protein	<i>Moth</i>	28.9
PTH 279	COG1725 predicted transcriptional regulator	<i>Moth</i>	110.1
PTH 280	COG4463 transcriptional repressor of stress genes	<i>Moth</i>	4.9
PTH 284	COG1943 transposase	<i>Dde</i>	40.3
PTH 302	COG0050 GTPase	<i>Pae</i>	52.3
PTH 304	Hypothetical membrane protein	<i>Sfu</i>	7.2
PTH 320	COG0087 ribosomal protein L3	<i>Moth</i>	19.9
PTH 332	COG0094 ribosomal protein L5	<i>Pae</i>	46.2
PTH 340	COG0201 preprotein translocase subunit	<i>Tte</i>	30.4
PTH 341	COG0024 methionine aminopeptidase	<i>Gsu</i>	50.0
PTH 348	Hypothetical protein	<i>Chy</i>	11.5
PTH 352	COG1122 ABC-type transporter, ATPase component	<i>Gsu</i>	6.7
PTH 363	Hypothetical protein	<i>Mac</i>	9.1
PTH 385	Hypothetical protein	<i>Pae</i>	5.6
PTH 482	COG4569 acetaldehyde dehydrogenase	<i>Bsu</i>	17.8
PTH 500	COG2002 regulator of stationary/spore expression	<i>Mhu</i>	8.5
PTH 520	Hypothetical protein	<i>Dde</i>	14.3
PTH 576	COG1116 ABC-type transporter, ATPase component	<i>Swol</i>	23.1
PTH 580	Hypothetical protein	<i>Moth</i>	43.1
PTH 585	COG1149 ATPase containing an inserted ferredoxin domain	<i>Sac</i>	7.5
PTH 592	COG1028 short-chain alcohol dehydrogenase	<i>Gsu</i>	21.4
PTH 607	Hypothetical regulator protein	<i>Pae</i>	5.8
PTH 610	COG2414 aldehyde:ferredoxin oxidoreductase	<i>Dde</i>	4.0
PTH 612	COG0476 dinucleotide-utilizing enzyme	<i>Moth</i>	9.1
PTH 616	COG1509 lysine 2,3-aminomutase	<i>Chy</i>	40.3
PTH 620	Hypothetical protein	<i>Chy</i>	40.3
PTH 627	Hypothetical protein	<i>Sac</i>	14.7
PTH 632	Hypothetical protein	<i>Sfu</i>	24.5
PTH 633	Hypothetical membrane protein	<i>Dde</i>	16.3
PTH 634	Hypothetical protein	<i>Moth</i>	10.0
PTH 656	COG0736 phosphopantetheinyl transferase	<i>Bsu</i>	17.1
PTH 715	Hypothetical protein	<i>Bfr</i>	25.6
PTH 774	Hypothetical membrane protein	<i>Cth</i>	54.9
PTH 782	Hypothetical protein	<i>Mac</i>	34.4
PTH 795	COG0537 diadenosine tetraphosphate hydrolase	<i>Sac</i>	17.8
PTH 797	Hypothetical protein	<i>Moth</i>	7.7
PTH 799	Hypothetical signaling protein	<i>Moth</i>	18.3
PTH 804	COG0740 protease subunit of ATP-dependent Clp proteases	<i>Moth</i>	23.8
PTH 810	COG0715 ABC-type transporter, periplasmic component	<i>Mac</i>	8.5
PTH 818	COG1792 cell shape-determining protein	<i>Moth</i>	4.6
PTH 840	COG2005 N-terminal domain of molybdenum-binding protein	<i>Moth</i>	15.5
PTH 842	COG0555 ABC-type transporter, permease component	<i>Moth</i>	9.7
PTH 850	COG3829 RocR transcriptional regulator	<i>Moth</i>	9.0
PTH 875	COG1420 HrcA transcriptional regulator	<i>Sfu</i>	5.2
PTH 892	COG0319 predicted metal-dependent hydrolase	<i>Chy</i>	53.9
PTH 944	COG1945 uncharacterized conserved protein	<i>Mac</i>	30.4
PTH 988	COG3830 ACT domain-containing protein	<i>Mth</i>	4.7
PTH 1016	COG2009 succinate dehydrogenase, cytochrome b subunit	<i>Gsu</i>	13.5
PTH 1018	COG0479 succinate dehydrogenase, Fe-S protein subunit	<i>Dde</i>	42.3
PTH 1041	COG0053 predicted Co/Zn/Cd cation transporters	<i>Cth</i>	4.3
PTH 1048	COG0124 histidyl-tRNA synthetase	<i>Dde</i>	7.1
PTH 1057	Hypothetical protein	<i>Dde</i>	17.8
PTH 1071	Hypothetical transcriptional regulator	<i>Bfr</i>	21.8
PTH 1075	COG1086 predicted nucleoside-diphosphate sugar epimerase	<i>Moth</i>	6.5
PTH 1078	COG1209 dTDP-glucose pyrophosphorylase	<i>Sac</i>	4.5
PTH 1088	Hypothetical membrane protein	<i>Dde</i>	52.3
PTH 1123	Hypothetical protein	<i>Chy</i>	28.4

Table 8. Continued.

Locus tag	Annotation	Donor	P value
PTH 1129	COG0169 shikimate 5-dehydrogenase	<i>Swol</i>	6.4
PTH 1132	COG0337 3-dehydroquinate synthetase	<i>Bsu</i>	5.8
PTH 1134	COG2804 type II secretory pathway ATPase	<i>Moth</i>	19.6
PTH 1158	COG0312 predicted Zn-dependent protease	<i>Mac</i>	8.5
PTH 1197	COG1189 predicted rRNA methylase	<i>Cth</i>	15.5
PTH 1202	COG0750 predicted Zn-dependent protease	<i>Mac</i>	34.6
PTH 1220	Hypothetical protein	<i>Tde</i>	30.4
PTH 1228	Hypothetical membrane protein	<i>Chy</i>	10.3
PTH 1233	COG3581 uncharacterized conserved protein	<i>Swol</i>	9.8
PTH 1239	COG0730 predicted permease	<i>Swol</i>	10.5
PTH 1254	COG0528 uridylate kinase	<i>Dde</i>	4.0
PTH 1256	COG1146 ferredoxin	<i>Swol</i>	60.8
PTH 1263	COG0442 prolyl-tRNA synthetase	<i>Bsu</i>	9.5
PTH 1270	COG0858 ribosome-binding factor A	<i>Swol</i>	17.8
PTH 1284	Hypothetical protein	<i>Mac</i>	5.2
PTH 1287	COG0527 aspartokinases	<i>Swol</i>	5.2
PTH 1302	Hypothetical protein	<i>Dde</i>	13.1
PTH 1304	COG1692 Uncharacterized conserved protein	<i>Cth</i>	4.3
PTH 1309	COG0182 predicted translation initiation factor 2B subunit	<i>Dde</i>	41.1
PTH 1315	COG0406 fructose-2,6-bisphosphatase	<i>Swol</i>	7.0
PTH 1320	COG1842 phage shock protein A	<i>Moth</i>	39.2
PTH 1326	COG3581 uncharacterized conserved protein	<i>Bsu</i>	25.1
PTH 1334	COG1302 uncharacterized conserved protein	<i>Moth</i>	16.0
PTH 1335	COG2301 citrate lyase beta subunit	<i>Moth</i>	20.6
PTH 1340	COG0145 acetone carboxylase, beta subunit	<i>Dde</i>	18.0
PTH 1366	COG4770 Acetyl/propionyl-CoA carboxylase, alpha subunit	<i>Mhu</i>	11.5
PTH 1370	Hypothetical protein	<i>Bsu</i>	6.4
PTH 1386	COG0205 6-phosphofructokinase	<i>Chy</i>	28.6
PTH 1392	Hypothetical protein	<i>Tde</i>	5.9
PTH 1396	COG2244 membrane protein involved in protein export	<i>Moth</i>	23.5
PTH 1400	COG0602 organic radical activating enzymes	<i>Moth</i>	23.5
PTH 1404	Hypothetical membrane protein	<i>Swol</i>	34.1
PTH 1420	COG0017 aspartyl/asparaginyl-tRNA synthetase	<i>Swol</i>	9.7
PTH 1429	COG0046 phosphoribosylformylglycinamide synthase	<i>Mac</i>	8.0
PTH 1439	COG2226 methylase involved in menaquinone biosynthesis	<i>Dde</i>	5.2
PTH 1445	COG3847 F1p pilus assembly protein	<i>Swol</i>	23.7
PTH 1450	COG2197 response regulator containing a CheY-receiver domain	<i>Swol</i>	6.5
PTH 1460	COG4326 sporulation control protein	<i>Swol</i>	14.2
PTH 1462	COG1226 Kef-type K ⁺ transport system	<i>Tte</i>	5.8
PTH 1471	COG1974 SOS-response transcriptional repressor	<i>Moth</i>	7.7
PTH 1474	COG2122 Uncharacterized conserved protein	<i>Bfr</i>	5.2
PTH 1475	COG0842 ABC-type multidrug transporter, permease component	<i>Moth</i>	25.5
PTH 1510	COG1073 hydrolases of the alpha/beta superfamily	<i>Mac</i>	12.5
PTH 1535	COG1975 xanthine and CO dehydrogenases maturation factor	<i>Dde</i>	22.5
PTH 1537	COG0471 di and tricarboxylate transporters	<i>Swol</i>	39.2
PTH 1547	Hypothetical protein	<i>Cth</i>	32.7
PTH 1553	COG2025 electron transfer flavoprotein, alpha subunit	<i>Dde</i>	16.1
PTH 1582	Hypothetical protein	<i>Cth</i>	6.5
PTH 1640	COG0700 uncharacterized membrane protein	<i>Sac</i>	15.5
PTH 1641	COG2715 uncharacterized membrane protein	<i>Sac</i>	19.6
PTH 1652	COG1335, amidase	<i>Moth</i>	6.5
PTH 1665	COG3857 ATP-dependent nuclease, subunit B	<i>Dde</i>	36.4
PTH 1699	COG0309 hydrogenase maturation factor	<i>Moth</i>	5.8
PTH 1701	COG1740 Ni,Fe-hydrogenase I small subunit	<i>Moth</i>	24.9
PTH 1702	COG0374 Ni,Fe-hydrogenase I large subunit	<i>Moth</i>	6.6
PTH 1703	COG0437 FeS cluster-containing hydrogenase component	<i>Moth</i>	5.8
PTH 1705	COG1942 uncharacterized protein	<i>Moth</i>	24.9
PTH 1709	COG1826 protein secretion pathway component	<i>Dde</i>	19.6
PTH 1714	COG5557 polysulphide reductase	<i>Sac</i>	12.5
PTH 1715	COG1826 protein secretion pathway component	<i>Dde</i>	23.8
PTH 1752	Hypothetical protein	<i>Mac</i>	4.0
PTH 1753	COG0669 phosphopantetheine adenylyltransferase	<i>Swol</i>	23.1
PTH 1771	COG4670 acyl CoA:acetate/3-ketoacid CoA transferase	<i>Dde</i>	19.6
PTH 1795	COG0194 guanylate kinase	<i>Mac</i>	16.1
PTH 1805	COG0284 orotidine-5'-phosphate decarboxylase	<i>Moth</i>	10.0
PTH 1818	COG0564 pseudouridylate synthases	<i>Mac</i>	19.9
PTH 1829	Hypothetical protein	<i>Sac</i>	4.7
PTH 1838	Hypothetical membrane protein	<i>Moth</i>	6.5
PTH 1880	Hypothetical membrane protein	<i>Moth</i>	5.2
PTH 1900	Hypothetical protein	<i>Dde</i>	16.7
PTH 1908	COG3267 type II secretory pathway, component	<i>Moth</i>	24.9
PTH 1910	Hypothetical transcriptional regulator	<i>Moth</i>	5.8
PTH 1953	COG0292 ribosomal protein L20	<i>Dde</i>	4.5
PTH 1958	Hypothetical protein	<i>Moth</i>	7.7

Table 8. Continued.

Locus tag	Annotation	Donor	P value
PTH 1967	Hypothetical protein	<i>Mac</i>	10.8
PTH 1989	COG1343 Uncharacterized protein	<i>Dde</i>	16.3
PTH 2000	COG1960 acyl-CoA dehydrogenase	<i>Dde</i>	59.8
PTH 2001	COG2086 electron transfer flavoprotein, beta subunit	<i>Sfu</i>	19.7
PTH 2006	Hypothetical protein	<i>Gsu</i>	16.0
PTH 2007	COG0860 N-acetylmuramoyl-L-alanine amidase	<i>Gsu</i>	23.1
PTH 2011	COG1894 NADH oxidoreductase, NADH-binding subunit	<i>Moth</i>	5.6
PTH 2016	Hypothetical protein	<i>Moth</i>	7.1
PTH 2018	Hypothetical protein	<i>Moth</i>	42.3
PTH 2021	Hypothetical protein	<i>Moth</i>	9.0
PTH 2023	Hypothetical protein	<i>Sac</i>	10.7
PTH 2024	Hypothetical protein	<i>Sfu</i>	10.5
PTH 2031	COG1284 uncharacterized conserved protein	<i>Moth</i>	4.8
PTH 2041	COG2197 response regulator containing a CheY-receiver domain	<i>Moth</i>	9.0
PTH 2064	COG1352 methylase of chemotaxis methyl-accepting protein	<i>Sfu</i>	23.5
PTH 2065	COG1871 chemotaxis protein, methylation of MCP proteins	<i>Swol</i>	5.6
PTH 2068	COG1191 DNA-directed RNA polymerase sigma subunit	<i>Moth</i>	16.0
PTH 2072	COG1298 flagellar biosynthesis pathway, component FlhA	<i>Moth</i>	5.8
PTH 2082	COG1843 flagellar hook capping protein	<i>Moth</i>	6.9
PTH 2083	Hypothetical protein	<i>Swol</i>	17.1
PTH 2084	COG2882 flagellar biosynthesis chaperone	<i>Cth</i>	15.5
PTH 2085	COG1157 flagellar type III secretory pathway ATPase	<i>Moth</i>	4.9
PTH 2112	COG1256 flagellar hook-associated protein	<i>Sfu</i>	29.5
PTH 2119	COG1291 flagellar motor component	<i>Moth</i>	9.0
PTH 2141	Hypothetical protein	<i>Mac</i>	9.1
PTH 2148	Hypothetical protein	<i>Moth</i>	5.8
PTH 2150	COG1351 predicted alternative thymidylate synthase	<i>Moth</i>	24.9
PTH 2155	COG0602 organic radical activating enzyme	<i>Chy</i>	84.2
PTH 2163	Hypothetical protein	<i>Moth</i>	4.0
PTH 2169	Hypothetical protein	<i>Tma</i>	6.5
PTH 2180	Hypothetical protein	<i>Gsu</i>	20.3
PTH 2196	Hypothetical protein	<i>Swol</i>	21.9
PTH 2202	COG0840 methyl-accepting chemotaxis protein	<i>Dde</i>	42.3
PTH 2208	Hypothetical protein	<i>Sfu</i>	16.7
PTH 2226	COG0177 predicted EndoIII-related endonuclease	<i>Mac</i>	5.1
PTH 2227	COG3330 uncharacterized conserved protein	<i>Sfu</i>	19.9
PTH 2231	COG0247 Fe-S oxidoreductase	<i>Moth</i>	9.0
PTH 2232	COG2186 transcriptional regulator	<i>Moth</i>	4.8
PTH 2249	Hypothetical protein	<i>Swol</i>	9.8
PTH 2262	Hypothetical protein	<i>Swol</i>	23.5
PTH 2281	COG1472 beta-glucosidase-related glycosidases	<i>Moth</i>	4.9
PTH 2291	COG2984 ABC-type transporter, periplasmic component	<i>Moth</i>	4.8
PTH 2303	COG1848 predicted nucleic acid-binding protein	<i>Moth</i>	6.5
PTH 2327	Hypothetical protein	<i>Sfu</i>	5.2
PTH 2361	COG5513, Predicted secreted protein	<i>Moth</i>	4.8
PTH 2373	Hypothetical protein	<i>Moth</i>	28.8
PTH 2374	Hypothetical protein	<i>Moth</i>	43.1
PTH 2387	COG0745 response regulator consisting of a CheY-receiver domain	<i>Moth</i>	30.4
PTH 2395	COG3436 transposase and inactivated derivative	<i>Moth</i>	4.9
PTH 2415	Hypothetical protein	<i>Moth</i>	36.5
PTH 2441	Hypothetical protein	<i>Moth</i>	9.0
PTH 2444	Hypothetical transcriptional regulator	<i>Sfu</i>	5.6
PTH 2447	Hypothetical protein	<i>Swol</i>	49.3
PTH 2458	Hypothetical protein	<i>Moth</i>	9.6
PTH 2461	Hypothetical protein	<i>Moth</i>	29.4
PTH 2487	Hypothetical protein	<i>Moth</i>	4.9
PTH 2554	COG1694 predicted pyrophosphatase	<i>Moth</i>	16.0
PTH 2556	Hypothetical protein	<i>Moth</i>	39.2
PTH 2575	COG1134 ABC-type transporter, ATPase component	<i>Swol</i>	18.0
PTH 2578	COG1088 dTDP-D-glucose 4,6-dehydratase	<i>Dde</i>	87.3
PTH 2581	Hypothetical protein	<i>Chy</i>	14.0
PTH 2589	COG1396 predicted transcriptional regulator	<i>Bfr</i>	8.3
PTH 2592	COG0491 Zn-dependent hydrolase	<i>Mst</i>	33.3
PTH 2594	COG0014 gamma-glutamyl phosphate reductase	<i>Moth</i>	12.5
PTH 2627	COG1977 molybdopterin converting factor, small subunit	<i>Mac</i>	5.1
PTH 2628	Hypothetical protein	<i>Tde</i>	7.0
PTH 2629	COG1606 ATP-utilizing enzyme	<i>Chy</i>	16.1
PTH 2634	COG0451 nucleoside-diphosphate-sugar epimerase	<i>Chy</i>	76.7
PTH 2642	Hypothetical protein	<i>Mac</i>	13.1
PTH 2667	COG0863 DNA modification methylase	<i>Sfu</i>	35.7
PTH 2668	Hypothetical proteins	<i>Mac</i>	11.1
PTH 2694	Hypothetical proteins	<i>Swol</i>	31.4
PTH 2704	COG0789 predicted transcriptional regulator	<i>Dde</i>	76.4

Table 8. Continued.

Locus tag	Annotation	Donor	P value
PTH 2712	COG0691 tmRNA-binding protein	<i>Mac</i>	7.1
PTH 2715	Hypothetical proteins	<i>Bfr</i>	23.7
PTH 2719	Hypothetical proteins	<i>Swol</i>	21.4
PTH 2745	COG4942 membrane-bound metallopeptidase	<i>Dde</i>	21.8
PTH 2746	COG2177 cell division protein	<i>Sac</i>	11.7
PTH 2748	Hypothetical protein	<i>Bfr</i>	25.1
PTH 2750	COG3959 transketolase, N-terminal subunit	<i>Swol</i>	56.9
PTH 2752	COG1186 protein chain release factor B	<i>Mac</i>	48.3
PTH 2777	Hypothetical membrane protein	<i>Tde</i>	7.5
PTH 2779	Hypothetical proteins	<i>Chy</i>	83.4
PTH 2781	Hypothetical proteins	<i>Chy</i>	70.2
PTH 2797	Hypothetical proteins	<i>Mac</i>	4.0
PTH 2802	Hypothetical proteins	<i>Bsu</i>	4.0
PTH 2803	COG0842 ABC-type multidrug transporter, permease component	<i>Chy</i>	113.1
PTH 2804	COG0842 ABC-type multidrug transporter, permease component	<i>Chy</i>	80.7
PTH 2807	Hypothetical protein	<i>Mac</i>	29.5
PTH 2809	Hypothetical protein	<i>Moth</i>	4.3
PTH 2812	COG0055 F0F1-type ATP synthase, beta subunit	<i>Chy</i>	53.1
PTH 2815	COG0712 F0F1-type ATP synthase, delta subunit	<i>Moth</i>	14.2
PTH 2827	COG1971 predicted membrane protein	<i>Mtth</i>	10.5
PTH 2830	COG0216 protein chain release factor A	<i>Bsu</i>	28.9
PTH 2831	Hypothetical protein	<i>Mac</i>	5.8
PTH 2832	Hypothetical protein	<i>Swol</i>	43.6
PTH 2833	COG0254 ribosomal protein L31	<i>Tde</i>	19.6
PTH 2835	COG0739 membrane proteins related to metalloendopeptidase	<i>Moth</i>	4.3
PTH 2845	COG1014 2-oxoacid:ferredoxin oxidoreductases, gamma subunit	<i>Mac</i>	25.6
PTH 2849	COG0436 Aspartate/tyrosine/aromatic aminotransferase	<i>Chy</i>	10.9
PTH 2857	COG1576 uncharacterized conserved protein	<i>Tde</i>	5.1
PTH 2860	Hypothetical protein	<i>Swol</i>	16.5
PTH 2862	COG0739 membrane protein related to metalloendopeptidase	<i>Sfu</i>	9.1
PTH 2866	Hypothetical protein	<i>Sfu</i>	33.3
PTH 2875	Hypothetical protein	<i>Moth</i>	4.3
PTH 2881	Hypothetical protein	<i>Moth</i>	39.2

*P values represent confidence levels estimated by the chi-square test of the codon-usage data.