



Figure S1. Sparse partial least squares discriminant analysis plot of metabolites in female and male *Phanaeus vindex* dung beetles following acclimation to six days of control (20 °C), low (20 ± 5 °C), and high (20 ± 12 °C) amplitude temperature fluctuation. Note that males were exposed to control and high fluctuation treatments only.

Table S1. Putative metabolites differentially expressed following acclimation to low amplitude temperature fluctuations (20 ± 5 °C) in the dung beetle *Phanaeus vindex*. Only the top 5 metabolites significantly up and downregulated are displayed. Fold changes are displayed relative to control kept at constant temperature (20 °C).

	Putative metabolite	Mass (m/z)	Retention time (minutes)	Log₂ fold change	Map
Upregulated	Not assigned	148.05	7.06	0.95	Not assigned
	Not assigned	148.01	9.96	0.46	Not assigned
	Not assigned	224.14	9.56	0.45	Not assigned
	Not assigned	222.13	9.37	0.36	Not assigned
	Not assigned	282.14	8.72	0.36	Not assigned
Downregulated	Not assigned	754.14	6.61	-1.70	Not assigned
	Cyclic ADP-ribose	541.06	1.35	-1.11	Not assigned

Table S2. Putative metabolites differentially expressed following acclimation to high amplitude temperature fluctuations (20 ± 12 °C) in the dung beetle *Phanaeus vindex*. Only the top 5 metabolites significantly up and downregulated are displayed. Fold changes are displayed relative to control kept at constant temperature (20 °C).

	Putative metabolite	Mass (m/z)	Retention time (minutes)	Log ₂ fold change	Map
Upregulated	PC (16:0)	577.38	13.28	3.02	Lipids: Glycerophospholipids
	PA(17:1(9Z)/ 22:6(4Z,7Z,10Z,13Z,1 6Z,19Z))	732.47	13.69	2.97	Lipids: Glycerophospholipids
	PG(40:7)	820.53	13.63	2.89	Lipids: Glycerophospholipids
	PG (6:0/8:0)	776.50	13.74	2.85	Lipids: Glycerophospholipids
	(9Z)-Tetradecenoic acid	226.19	13.38	2.67	Lipids: Fatty Acyls
Downregulated	Not assigned	200.23	4.88	-0.62	Not assigned
	Not assigned	127.14	4.87	-0.53	Not assigned
	FA (18:0)	341.29	12.28	-0.38	Lipids: Fatty Acyls
	Not assigned	101.12	20.89	-0.20	Not assigned

Table S3. Putative metabolites differentially expressed following acclimation to both high and low amplitude temperature fluctuations in the dung beetle *Phanaeus vindex*. Only the top 5 metabolites significantly up and downregulated are displayed, “contraregulated” indicates metabolites that are upregulated in one acclimation group and downregulated in the other. Fold changes are displayed relative to control kept at constant temperature.

	Putative metabolite	Map	Mass (m/z)	Retention time (minutes)	Log ₂ fold change after high amplitude fluctuations	Log ₂ fold change after low amplitude fluctuations
Upregulated	CL(18:2(9Z,12Z)/18:2(9Z,12Z)/18:2(9Z,12Z)/18:1(11Z))	Not assigned	725.49	14.87	1.16 (not detected in control, relative expression to low amplitude group).	
	LysoPE(0:0/22:2(13Z,16Z))	Lipids: Glycerophospholipids	533.35	13.32	3.32	1.75
	Not assigned	Not assigned	614.37	13.49	2.06	1.03
	Not assigned	Not assigned	784.50	12.51	2.02	1.37
	3-O-(Galb)-(25R)-12-oxo-5alpha-spirostan-3beta-ol	Lipids: Sterol Lipids	608.39	12.56	1.97	1.16
Downregulated	His-Leu-Leu-Met	Peptide(tetra-)	256.14	22.90	-0.94	-0.71

	PE(22:1(13Z)/P-18:1(11Z))	Lipids: Glycerophospholipids	391.81	22.37	-0.10	-0.24
Contraregulated	Not assigned	Not assigned	754.23	6.65	0.76	-1.32
	Not assigned	Not assigned	393.05	0.70	-0.31	0.30
	Not assigned	Not assigned	266.17	12.37	-0.29	0.24
	Not assigned	Not assigned	127.14	20.96	-0.28	0.13
	Not assigned	Not assigned	192.15	9.36	-0.15	0.12

Table S4. Significantly differentially expressed transcripts following acclimation to low amplitude temperature fluctuations in the dung beetle *Phanaeus vindex*. GO terms are listed only for molecular function. Only the top 5 up and down-regulated transcripts are given.

	Description	Log ₂ Fold Change	GO Names
Upregulated	agrin-like isoform X4	5.70	calcium ion binding; collagen binding; extracellular matrix binding
	titin isoform X5	5.16	None assigned
	ubiquitin carboxyl-terminal hydrolase 31 isoform X2	4.99	hydrolase activity; hiol-dependent ubiquitinyl hydrolase activity
	ATP-binding cassette sub-family G member 1-like isoform X2	4.92	ATP binding; ATPase activity
	transcription factor E2F5	4.90	DNA binding; DNA-binding transcription factor activity
Downregulated	receptor-type tyrosine-phosphatase F-like	-7.48	protein tyrosine phosphatase activity; phosphatase activity
	uncharacterized protein LOC111427918	-6.34	None assigned
	acetyl- carboxylase	-5.90	acetyl-CoA carboxylase activity; biotin carboxylase activity; ATP binding; metal ion binding

receptor-type tyrosine-phosphatase F-like isoform X1	-5.58	protein tyrosine phosphatase activity
receptor-type tyrosine-phosphatase U isoform X1	-5.55	None assigned

Table S5. Significantly differentially expressed transcripts following acclimation to high amplitude temperature fluctuations in the dung beetle *Phanaeus vindex*. GO terms are listed only for molecular function. Only the top 5 up and down-regulated transcripts are given.

	Description	Log ₂ Fold Change	GO Names
Upregulated	cysteine-rich venom 6-like	8.27	None assigned
	isopentenyl diphosphate synthase	7.62	None assigned
	cystine knot toxin	6.94	insulin-like growth factor binding
	retinol-binding pinta-like	6.71	transporter activity
	farnesyl pyrophosphate synthase-like	6.66	None assigned
Downregulated	juvenile hormone acid O-methyltransferase-like	-5.15	None assigned
	lipase member I-like	-5.12	carboxylic ester hydrolase activity
	von Willebrand factor-like	-4.37	acetyl-CoA carboxylase activity; biotin carboxylase activity; ATP binding; metal ion binding

von Willebrand factor-like	-4.12	None assigned
acetyl- carboxylase isoform X3	-4.00	acetyl-CoA carboxylase activity; biotin carboxylase activity; ATP binding; metal ion binding

Table S6. Significantly differentially expressed transcripts following acclimation to both high and low amplitude temperature fluctuations in the dung beetle *Phanaeus vindex*. GO terms are listed only for molecular function. Only the top 5 up and down-regulated transcripts are given.

	Description	Log ₂ Fold Change After Low Amplitude	Log ₂ Fold Change After High Amplitude	GO Names
Upregulated	kelch 26 amino acid transporter	6.49	6.50	protein binding
	AVT1A isoform X2	5.55	6.29	None assigned
	ankyrin repeat domain- containing 2-like	5.08	6.07	protein binding
	nucleic-acid-binding from mobile element jockey-like	3.72	6.06	None assigned
	homeobox 5-like isoform X2	6.03	6.03	None assigned
Downregulated	probable chitinase 10	-4.80	-4.59	chitin binding
	cysteine-rich venom 6- like	-3.45	-3.99	None assigned
	CREG1 isoform X2	-5.15	-3.88	FMN binding; oxidoreductase activity
	fatty acid synthase-like	-3.71	-3.16	None assigned

serine threonine-
kinase

endoribonuclease IRE1

-4.00

-2.93

kinase activity
