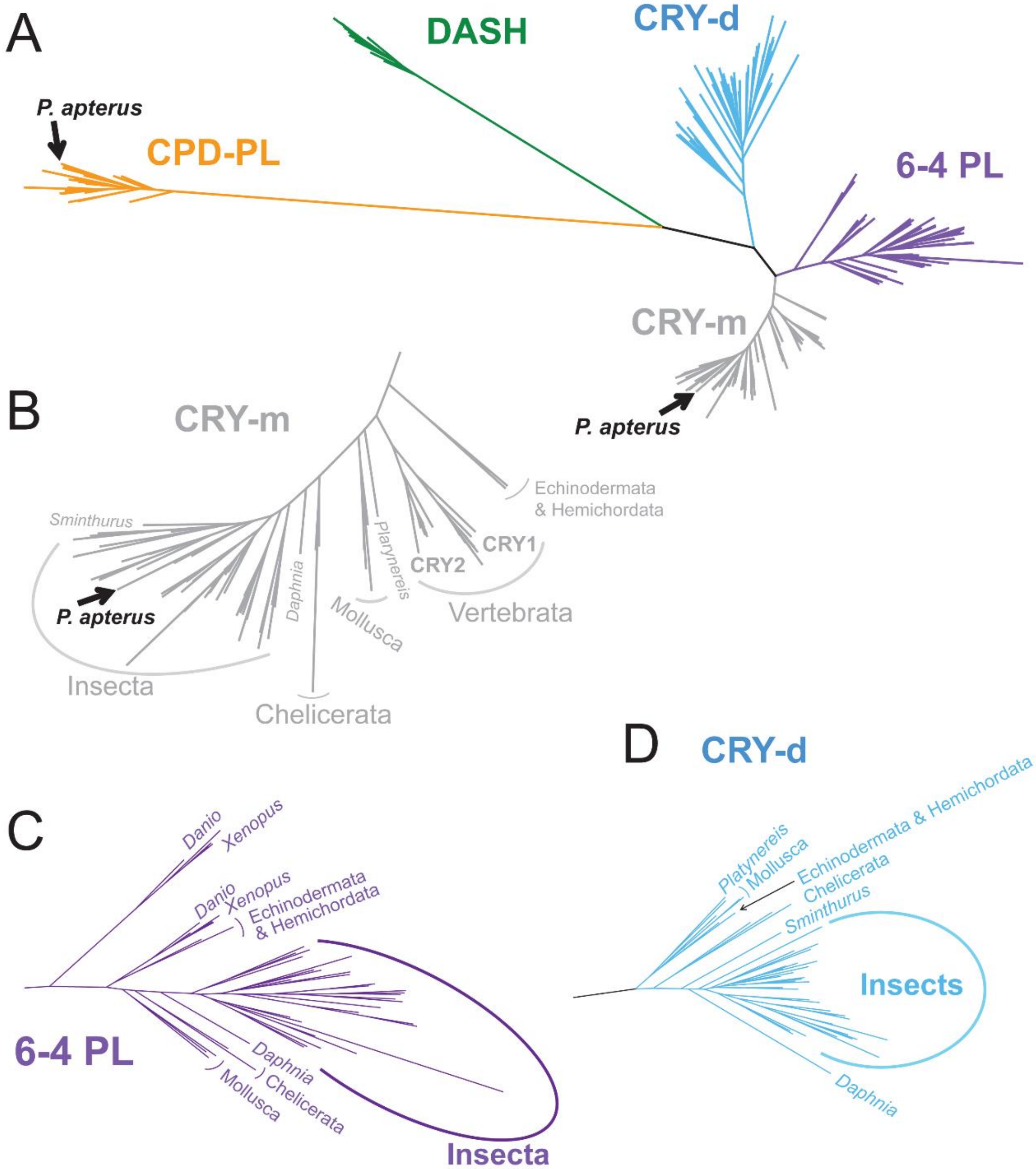
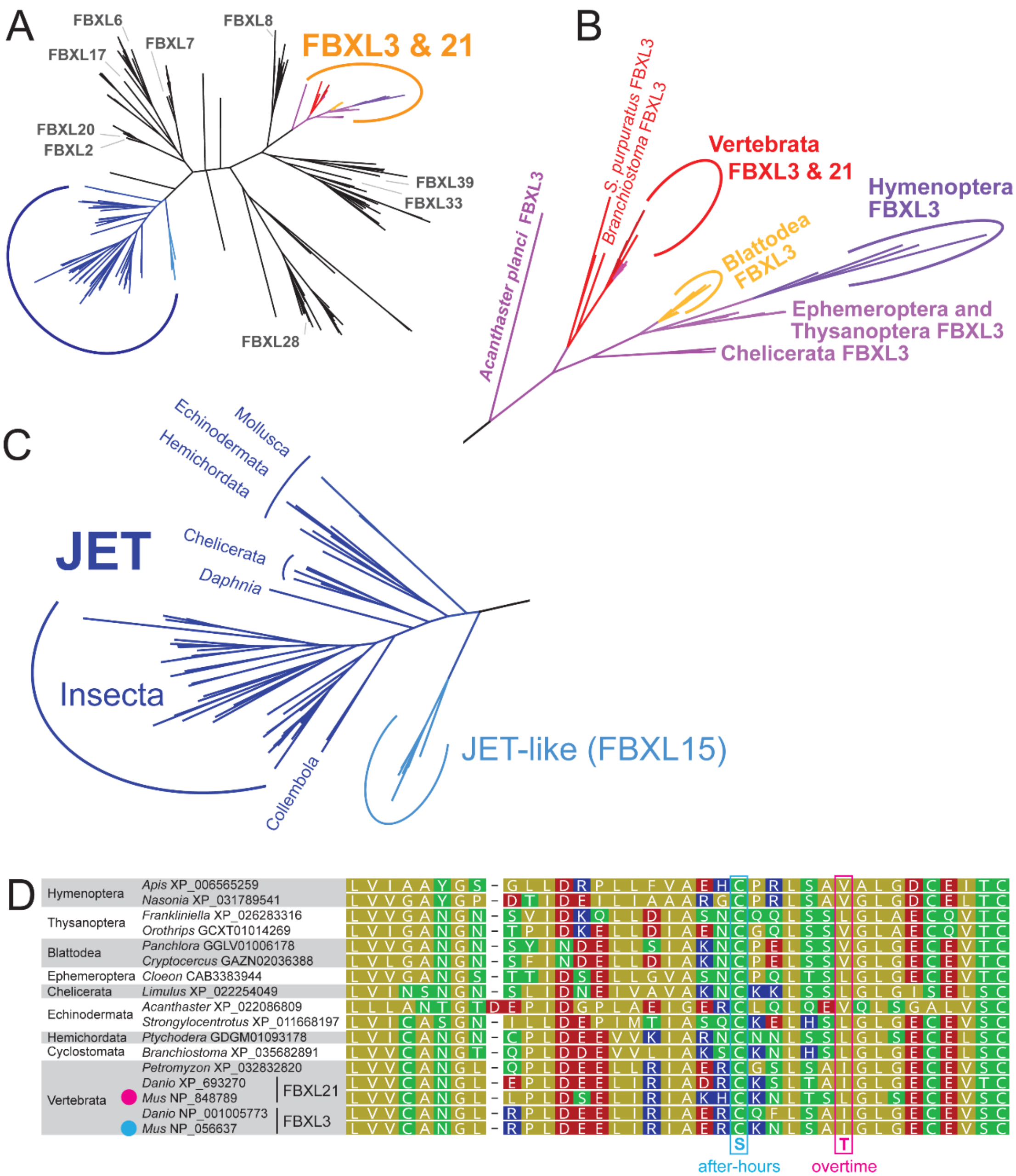
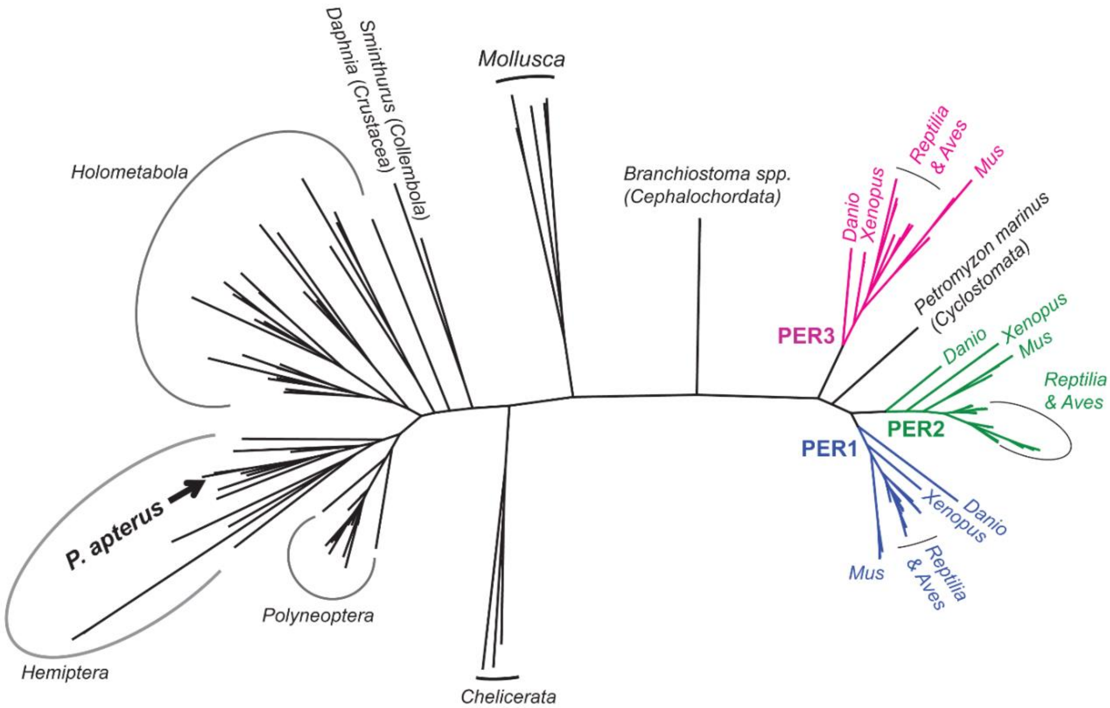


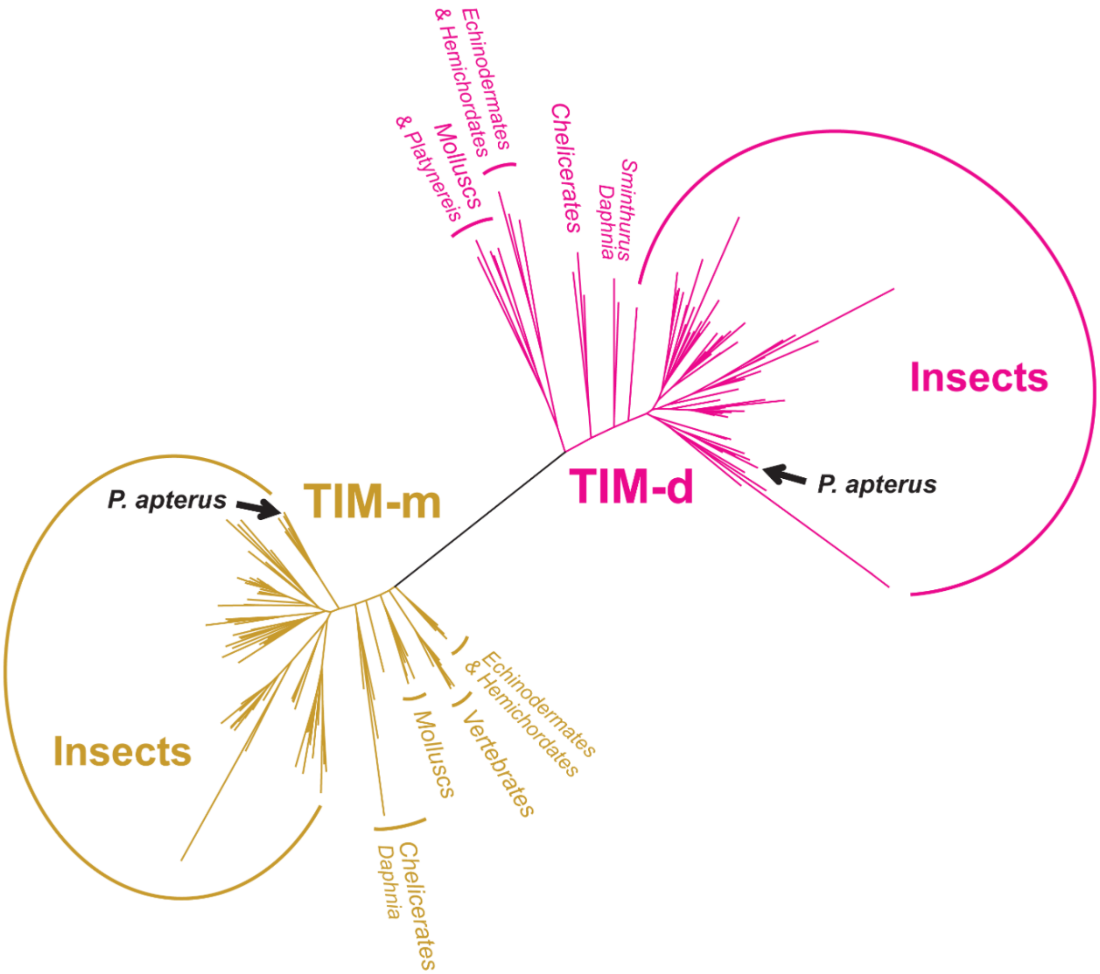
Supplementary Figure 1. Phylogeny of Metazoan CRYPTOCHROMES. (*A*) Unrooted tree of 210 Metazoan protein sequences (RAxML, GAMMA-based Likelihood: log -118860.635040) illustrates that CRYs cluster to five distinct groups: CYCLOBUTANE PYRIMIDINE DIMER PHOTOLYASE (CPD-PL, orange), DASH (*Drosophila*, *Arabidopsis*, *Synechocystis*, *Human*)-type cryptochrome (green), mammalian and *Drosophila*-type of cryptochrome (CRY-m, grey; CRY-d, blue), and 6-4 DNA photolyase (6-4 PL, deep purple). (*B-D*) Depict details of particular tree regions with representative taxa. Positions of *P. apterus* CRYs are highlighted.



Supplementary Figure 2. Phylogeny of Metazoan JETLAG and FBXL3/21 proteins. (*A*) The unrooted tree containing representative metazoan FBXL proteins (mouse proteins are by grey names) with a detailed dataset of JETLAG (JET) and FBXL21/3 sequences (242 proteins in total, RAxML, GAMMA-based Likelihood: -108138.373258). (*B*) Detail of the tree depicting phylogeny of FBXL3 / FBXL21. (*C*) Phylogeny of JETLAG homologs and its related JET-like (FBXL15). (*D*) Alignment of FBXL3 and FBXL21, two vertebrate paralogs represented by the zebrafish (*Danio rerio*) and mouse (*Mus musculus*), compared to the ancestral sequence from *Petromyzon* and to FBXL3 representing major metazoan groups in which the protein was identified. The blue and red rectangles highlight the positions that are substituted in *after-hours* in the mouse FBXL3 (31), highlighted by the light blue full circle, and *overtime* mutant in the mouse FBXL21 (13), highlighted by magenta full circle, respectively.



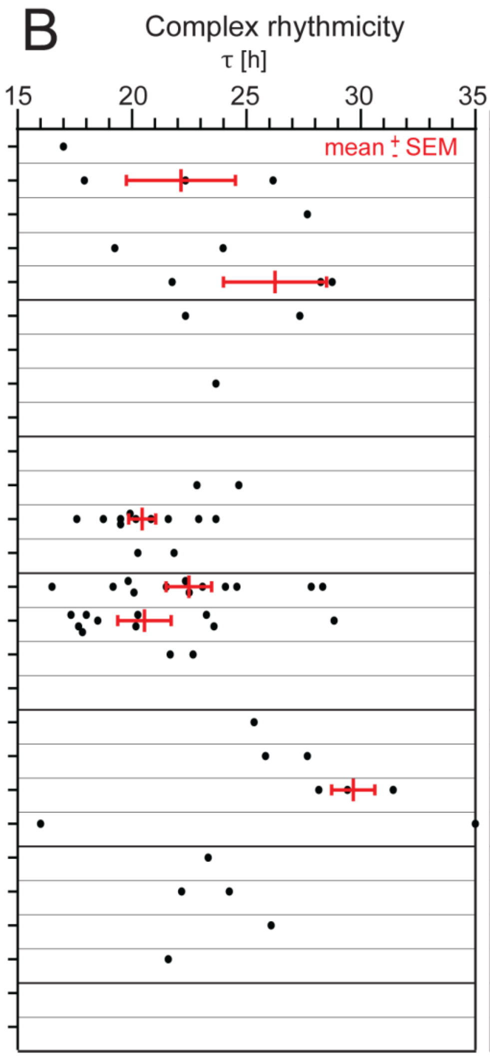
Supplementary Figure 3. Phylogeny of Metazoan PERIOD proteins (PER). The unrooted tree containing representative Metazoan PER proteins (133 proteins in total, RAxML, GAMMA-based Likelihood: -185735.690583).



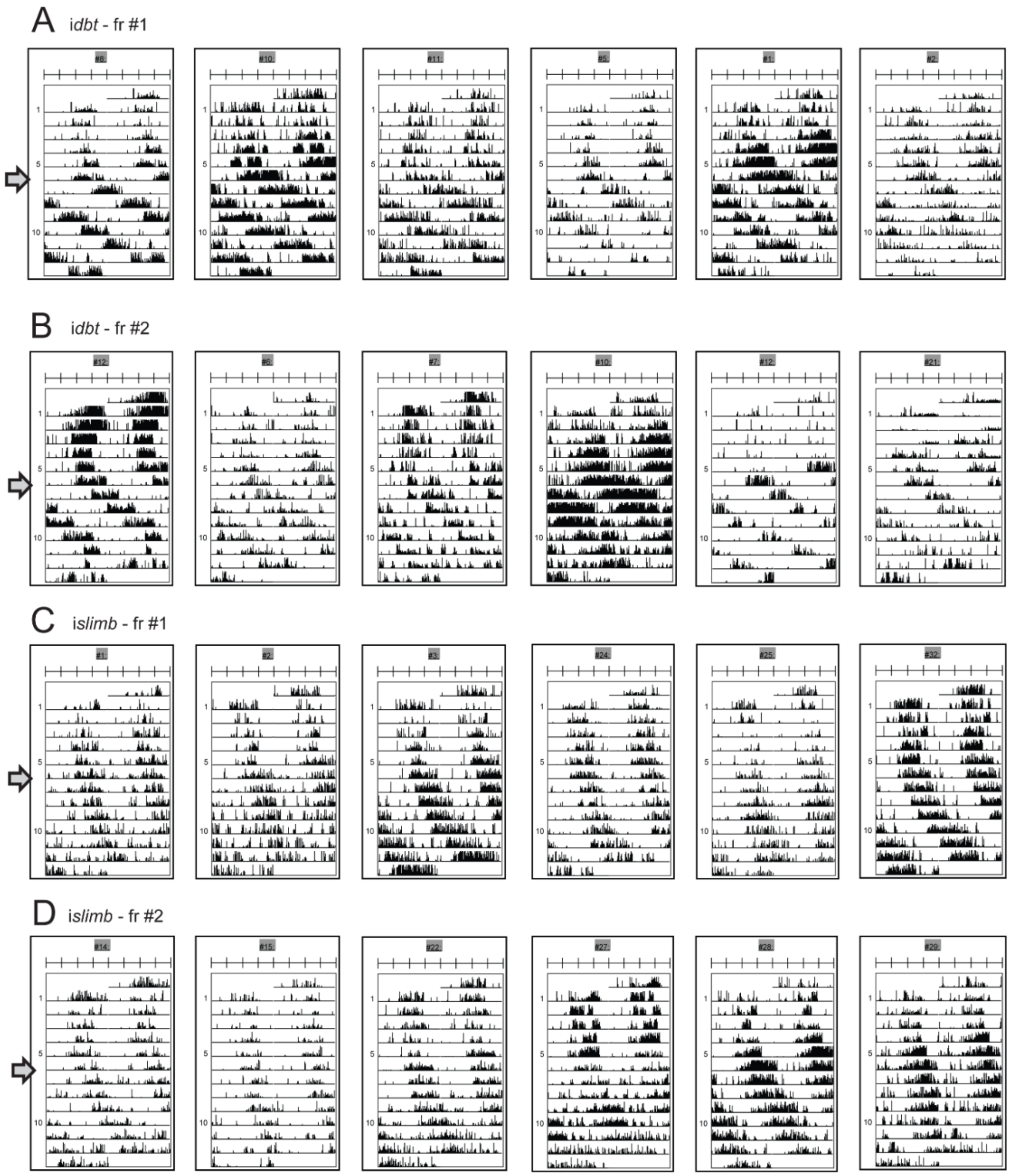
Supplementary Figure 4. Phylogeny of TIMELESS proteins indicates clear and unambiguous separation of TIM-d and TIM-m clusters. The tree was constructed from the protein alignment of 167 metazoan sequences using RAxML (GAMMA-based Likelihood: -245239.706545). The mammalian-type of TIM (TIM-m, in gold) was found in all representatives of Metazoan species (see table S1 for detail list), whereas the *Drosophila*-type TIM (TIM-d, in red) is present in the majority of insect species, Collembola (*Sminthurus*), Crustacea (*Daphnia*), Chelicerata, Mollusca, Hemichordata and Echinodermata. Positions of *P. apterus* TIM-m and TIM-d are highlighted by black arrows.

A

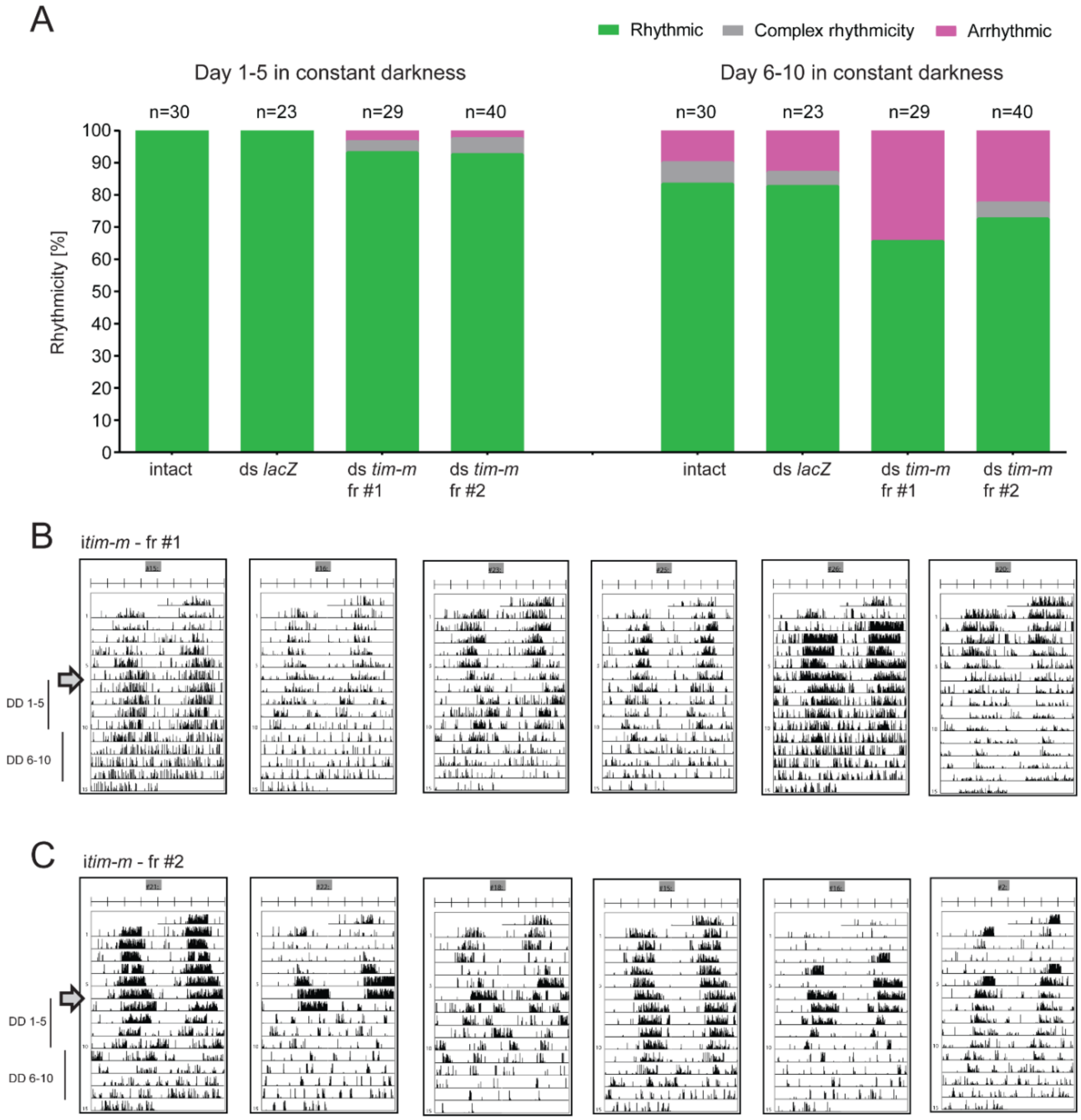
	n	Rhythmicity [%] strong	Rhythmicity [%] com-plex	Rhythmicity [%] arr.	τ [h]	+/- SEM [h]
control (*lacZ*)	110	94.5	1.0	4.0	-	-
Clk fr #1	26	3.8	11.5	96.2	22.1	2.4
Clk fr #2	37	2.7	2.7	94.6	-	-
cyc/Bmal fr #1	20	10.0	10.0	80.0	-	-
cyc/Bmal fr #2	29	6.9	13.8	79.3	26.3	2.3
cwo fr #1	25	80.0	8.0	12.0	-	-
cwo fr #2	29	86.2	0.0	13.8	-	-
Pdp1 fr #1	36	8.3	2.8	88.9	-	-
Pdp1 fr #2	20	0.0	0.0	100.0	-	-
vri fr #1	25	88.0	0.0	12.0	-	-
vri fr #2	24	91.7	8.3	0.0	-	-
cry-m fr #1	25	36.0	40.0	24.0	20.4	0.6
cry-m fr #2	22	40.9	9.0	50.0	-	-
per fr #1	32	50	37.5	12.5	22.5	1.0
per fr #2	30	43.3	36.7	20.0	20.5	1.2
tim-d fr #1	26	92.3	7.7	0.0	-	-
tim-d fr #2	18	94.4	5.6	0.0	-	-
tim-m fr #1	22	94.1	22.7	13.6	-	-
tim-m fr #2	26	92.9	7.7	23.1	-	-
dbt fr #1	17	63.6	0.0	5.9	29.7	0.9
dbt fr #2	22	69.2	0.0	13.6	-	-
nmo fr #1	16	75.0			-	-
nmo fr #2	17	70.6			-	-
sgg fr #1	15	80.0			-	-
sgg fr #2	17	94.1			-	-
slimb fr #1	17	94.1	0.0	5.9	-	-
slimb fr #2	22	86.4	0.0	13.6	-	-



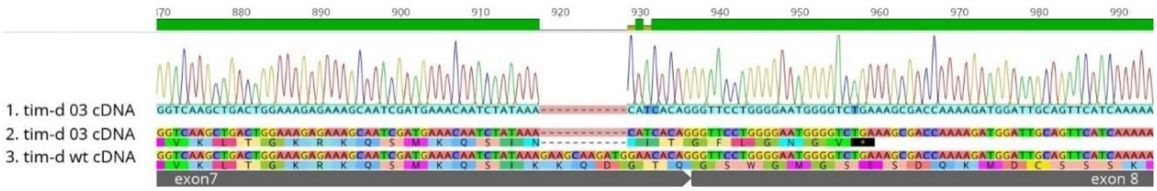
Supplementary Figure 5. Free-running period of RNAi animals with complex rhythmicity. (*A*) Summary of the gene silencing describing its impact on the behavioral rhythmicity shown as % of males demonstrating strong rhythmicity, complex rhythmicity, and arrhythmicity. fr #1 and fr #2 = non-overlapping dsRNA fragment 1 and 2, respectively. (*B*) Individual free-running period (τ) values are shown as a dot for each male with complex rhythmicity; red bars represent means ± SEMs (calculated if >10 % individuals demonstrated rhythmicity). Columns depict the mean free-running period (τ), standard error of mean (± SEM).



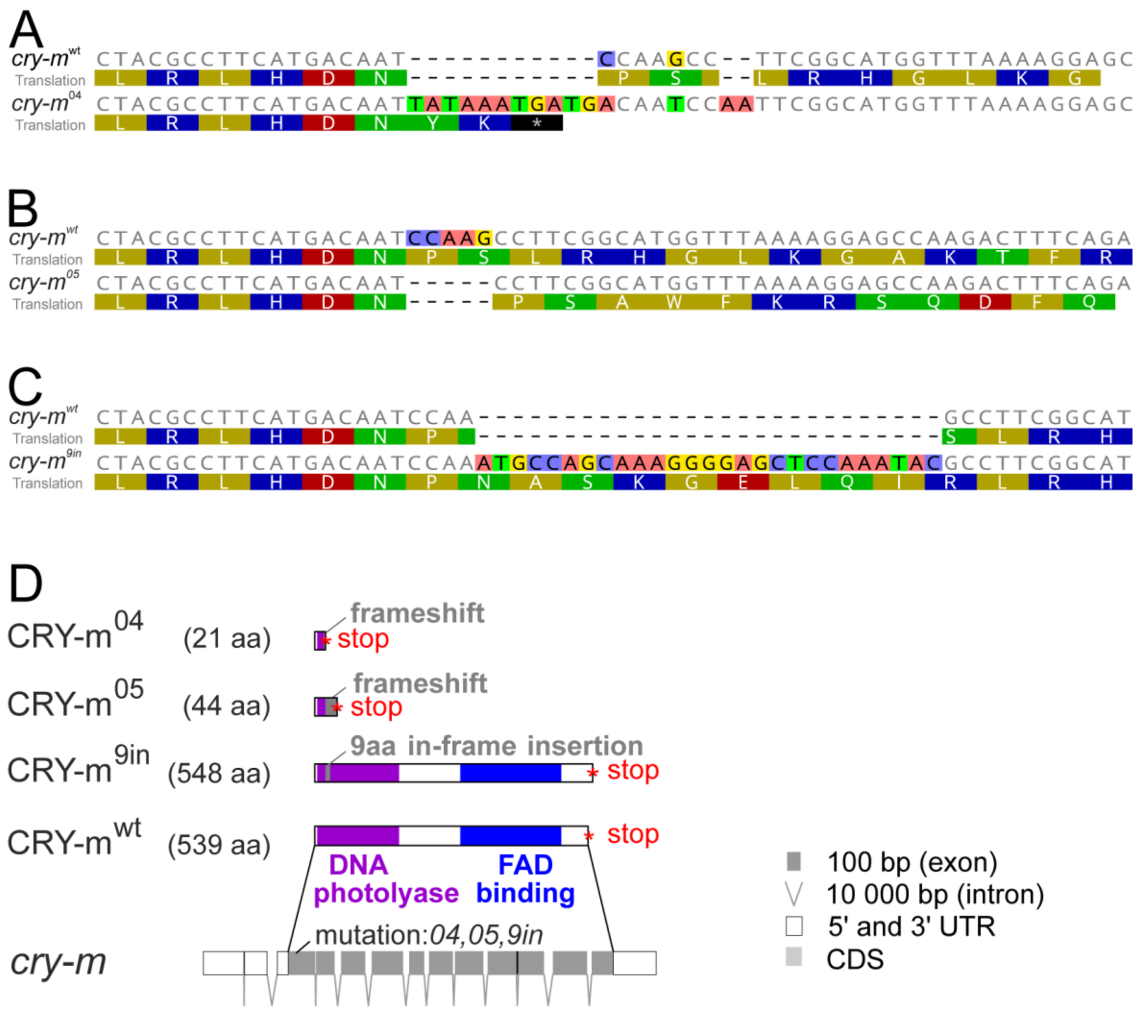
Supplementary Figure 6. *P. apterus* activity after *dbt* (i*dbt*) and *slimb* (i*slimb*) knock-down shown as double- plotted actograms. The activity of adult males was recorded at 25 ºC and light-dark cycles for five days. Then, males were released to constant-dark conditions (indicated by grey arrow). Typical examples of: (*A*) i*dbt* fr #1, (*B*) i*dbt* fr #2, (*C*) i*slimb* fr #1, (*D*) i*slimb* fr #2 knock-down are shown. fr #1 and fr #2 refer to non-overlapping dsRNA fragment 1 and 2, respectively.



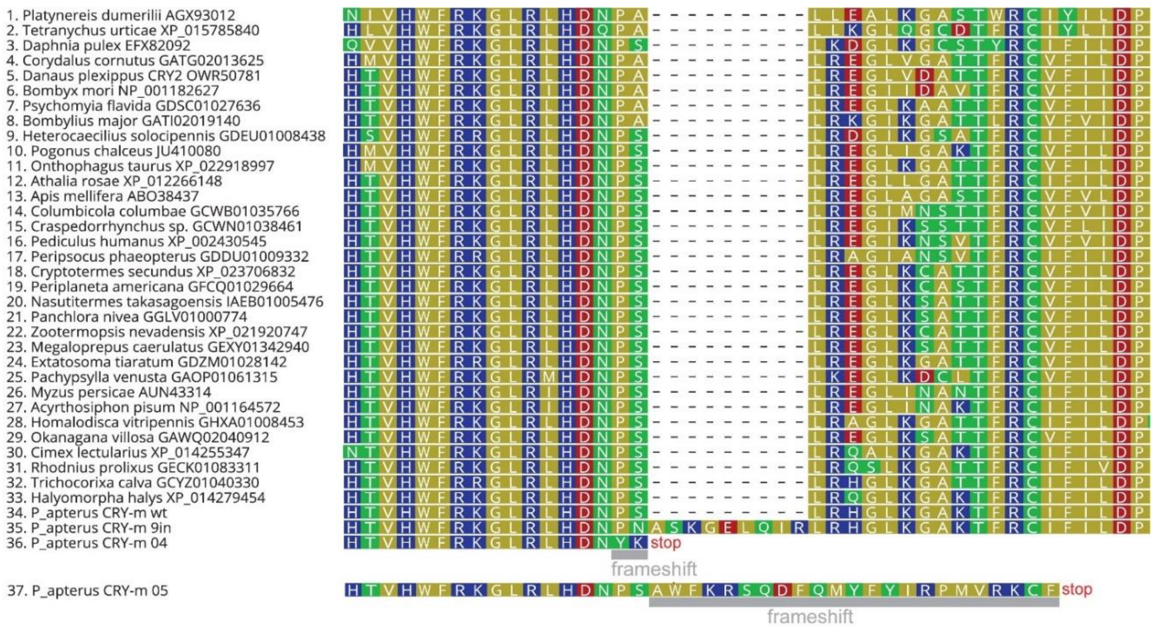
Supplementary Figure 7. *Timeless-m* silencing influences rhythmicity in *P. apterus*. (*A*) Summary of the rhythmicity during first 5 days of constant darkness (left) and second half of constant darkness (all recorded at 25 ºC). (*B-C*) Examples of double-plotted actograms of *tim-m* silenced males (i*tim-m*). The activity of adult males was recorded at 25 ºC and light-dark cycles for five days. Then, males were released to constant-dark conditions (indicated by grey arrow).



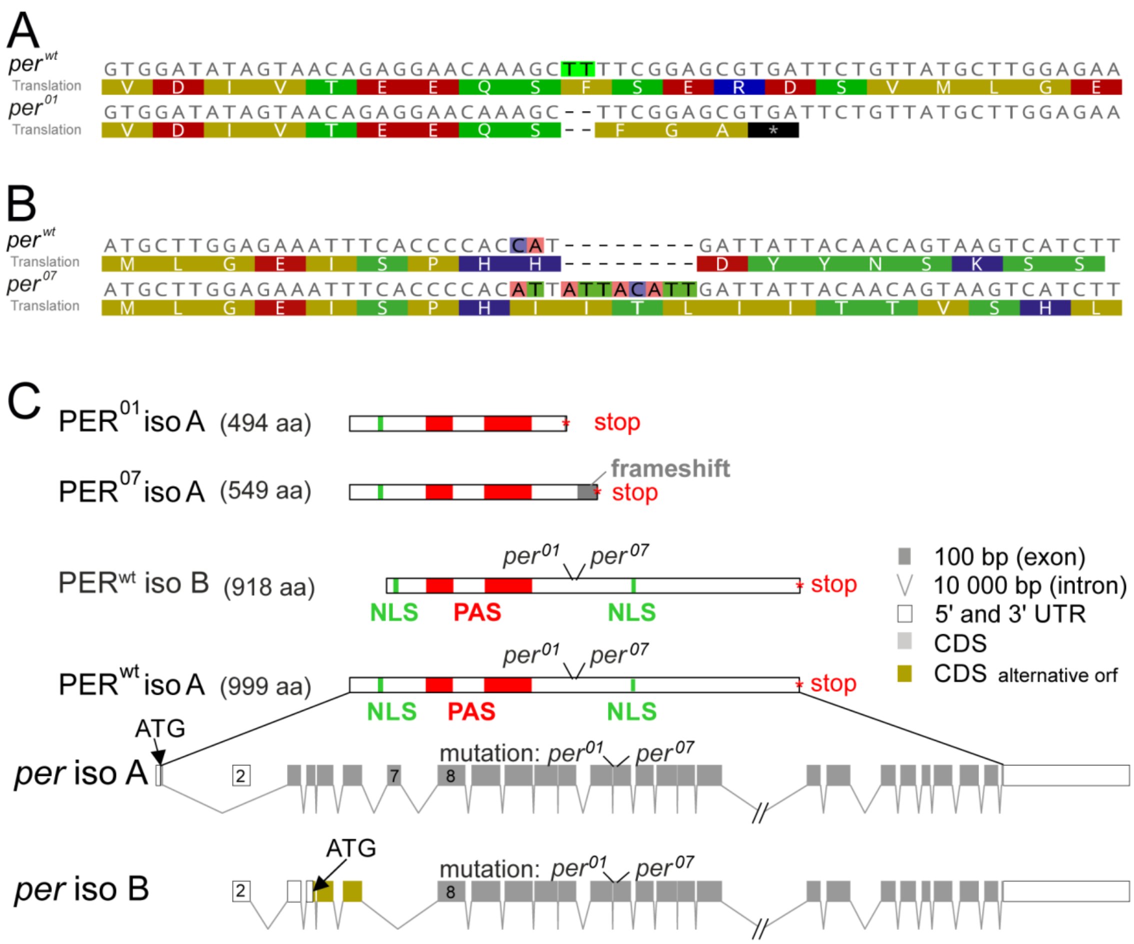
Supplementary Figure 8. Deletion in *tim-d*^{03} does not influence splicing of exon 7 and 8. To clarify if the 11bp deletion and two in-frame substitutions might influence *tim-d* splicing, total RNA was isolated from the brains of *tim-d*^{03} homozygous mutant animals, mRNA reverse transcribed, and the corresponding region of *tim-d* transcript PCR amplified. The chromatogram obtained from direct sequencing of *tim-d*^{03} PCR product is shown in the first line of the alignment. The third line corresponds to the cDNA of the wild-type control with exon position highlighted underneath. Protein sequences are shown below *tim-d*^{03} and *tim-d*^{wt}, respectively. The black box corresponds to the stop codon (coded by TGA).



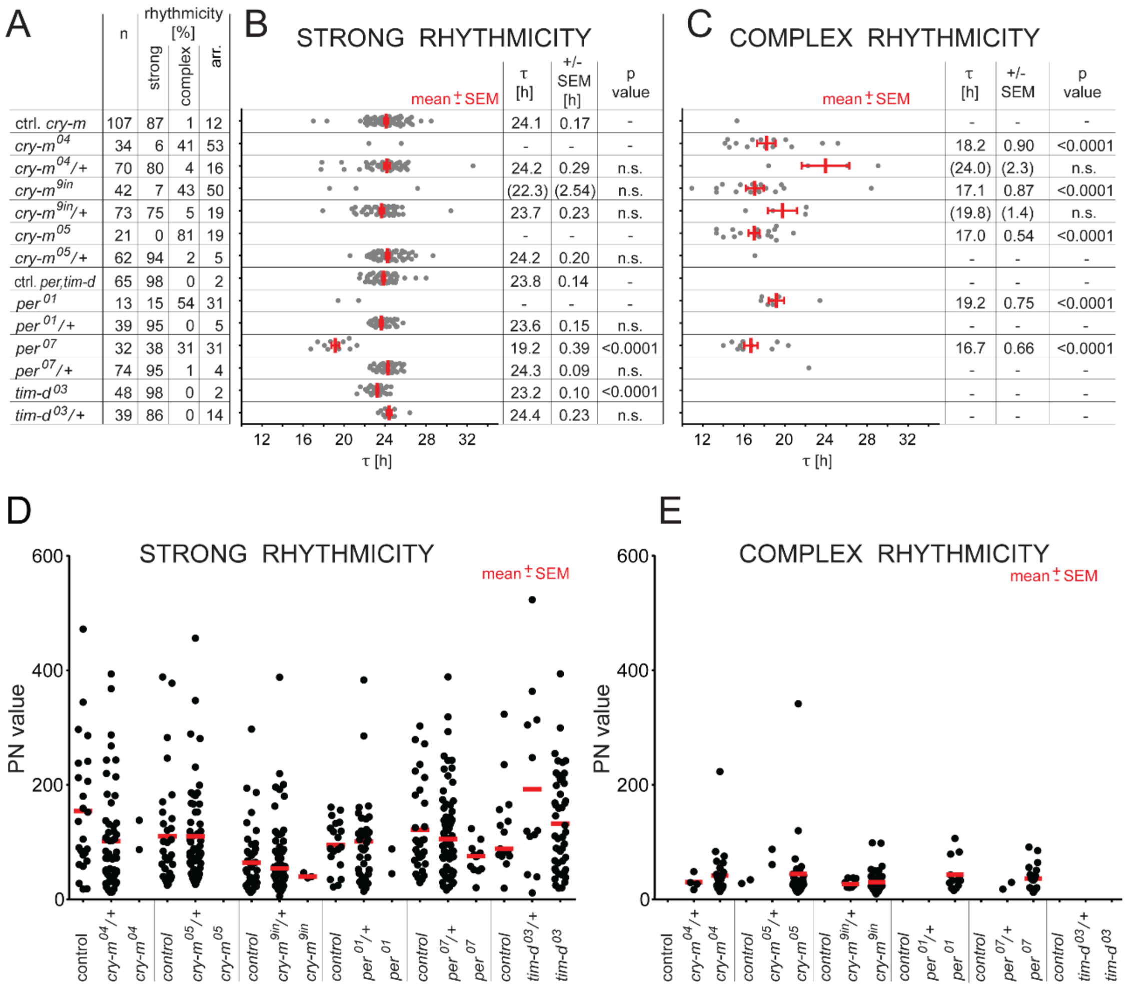
Supplementary Figure 9. Overview of *P. apterus cryptochrome-m* engineered mutants. (*A*) DNA insertion of a sequence in *cry-m^{04}* mutant contains an in-frame stop codon. (*B*) Two-base pair deletion in *cry-m^{05}* mutant results in a frameshift. The stop codon is downstream of the presented region. (*C*) 27-base pair in-frame insertion results in additional 9 amino acids in CRY-m^{9in}. (*D*) *cryptochrome-m* gene model (bottom) with highlighted exons and introns (note different scale for exons and introns). Corresponding wild-type protein is shown above the gene model with the highlighted position of mutations, protein domains, and the C-terminus (stop). Predicted CRY-m^{9in} mutant protein contains nine-amino acid insertion (see Supplementary Data Fig. 10 for protein alignment of this region with CRY proteins from different insect species). In contrast to *cry-m*^{9in}, two other mutants, *cry-m*^{04} and *cry-m*^{05}, are *bona fide* loss-of-function mutants because the indels result in frameshifts leading to premature stop codons. Predicted protein sequences are shown at the top of the panel.



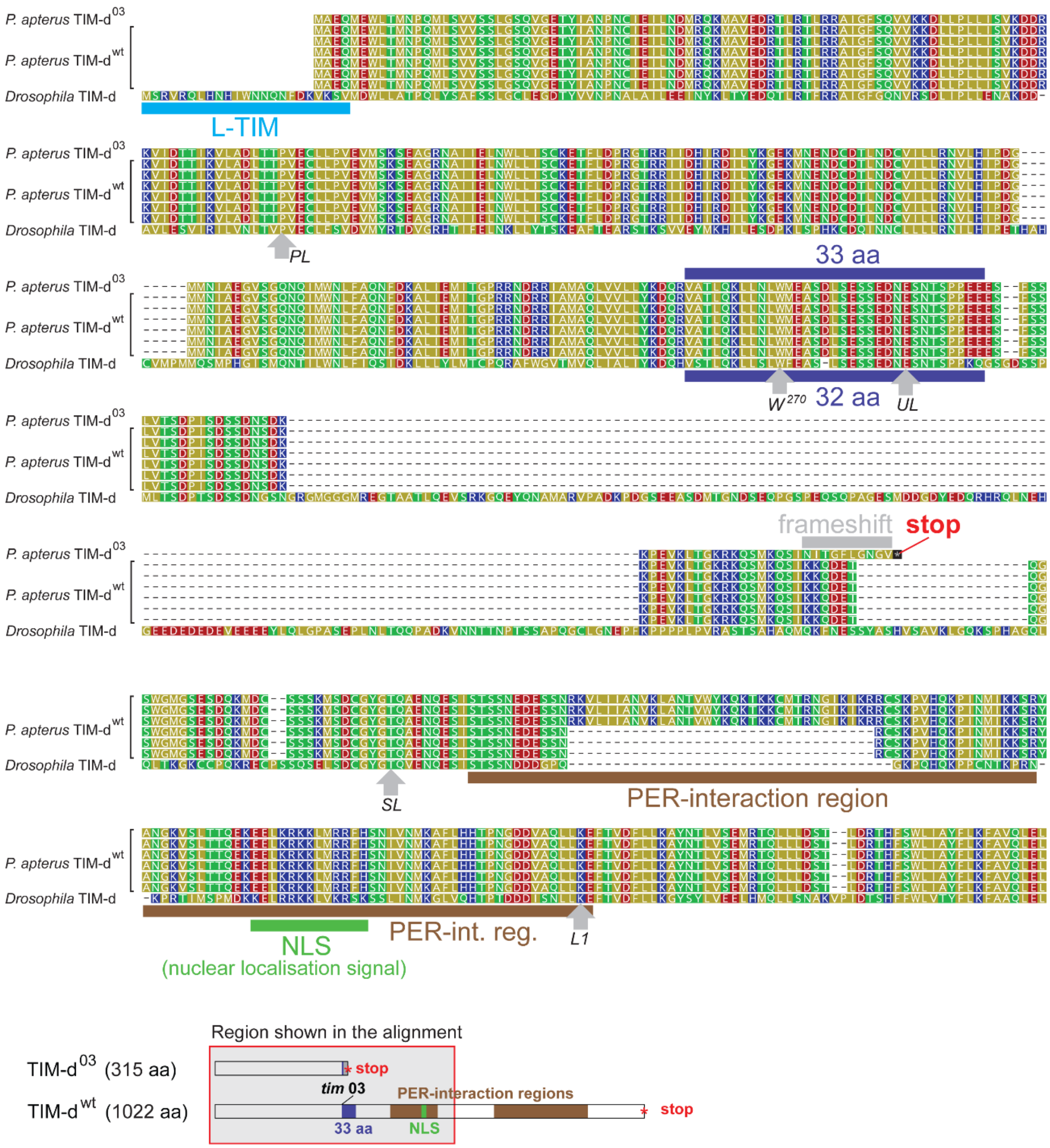
Supplementary Figure 10. *Cryptochrome-m* engineered mutants target evolutionarily conserved region in CRY-m. Representative CRY-m proteins were aligned with protein sequences of three *P. apterus* mutants. Two of them, CRY-m^{04} and CRY-m^{05} (No. 36 and No. 37, respectively), are terminated prematurely (indicated as a stop). The third mutant, CRY-m^{9in} (No. 35), contains an in-frame insertion of nine amino acids into the evolutionarily conserved CRY-m region.



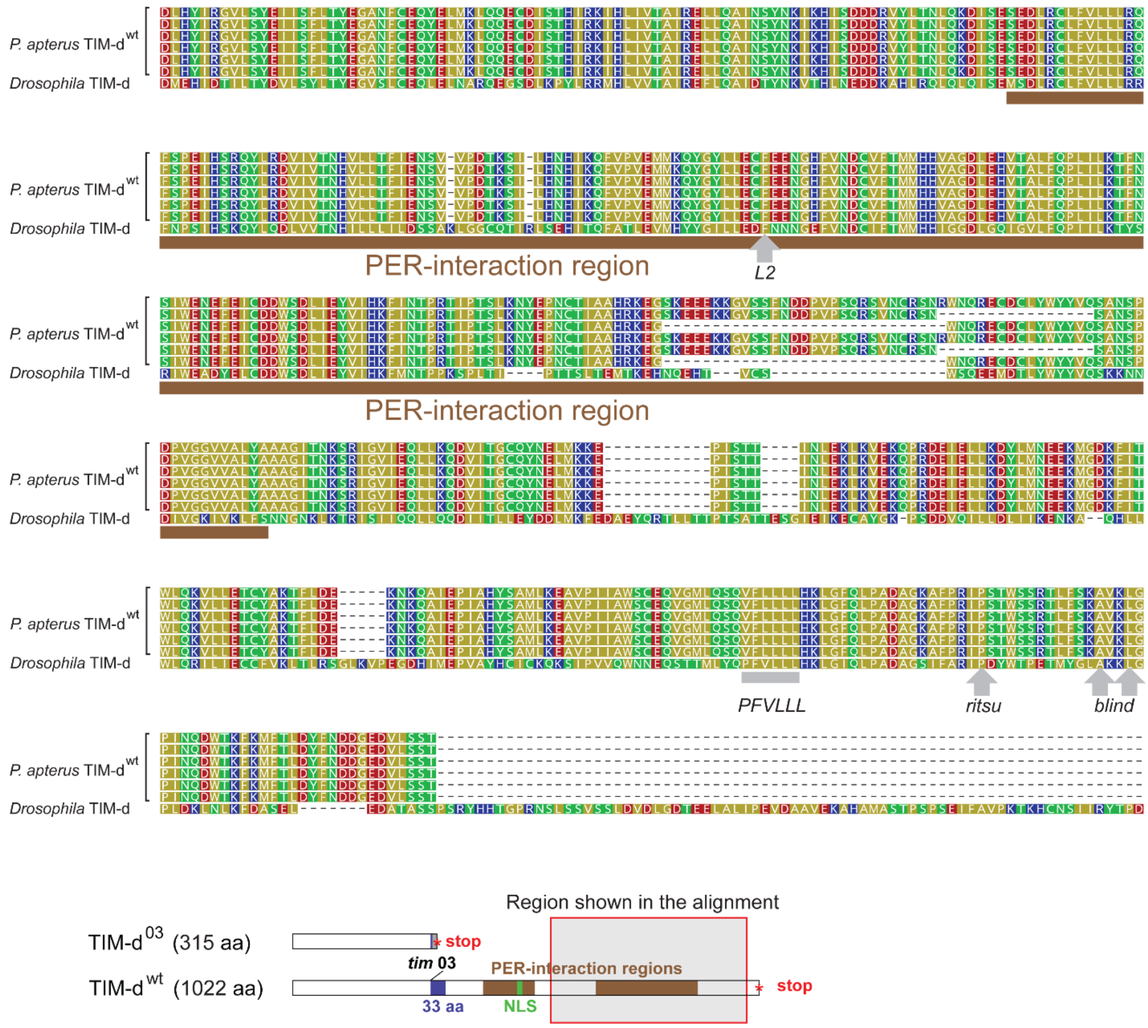
Supplementary Figure 11. Overview of *P. apterus period* engineered mutants. (*A*) A two-base pair DNA deletion in *per*^{01}mutant results in a frameshift and stop codon (depicted as an asterisk in black background). (*B*) Eight-base pair deletion in *per*^{07} mutant results in a frameshift. The stop codon is downstream of the presented region. (*C*) Two transcript isoforms differing by alternative transcription starts (ATG) and alternative retention of exon 7 are presented in *period* gene models (bottom) with highlighted exons and introns (note different scale for exons and introns). The open reading frames are identical for isoforms A and B from exon 8. Therefore, despite the different N terminal regions, mutations *per*^{01} and *per*^{07} identically shorten the resulting mutant proteins. Corresponding wild-type protein is shown above the gene model with the highlighted position of mutations, protein domains, and the C-terminus (stop). Predicted protein sequences are shown at the top of the panel.



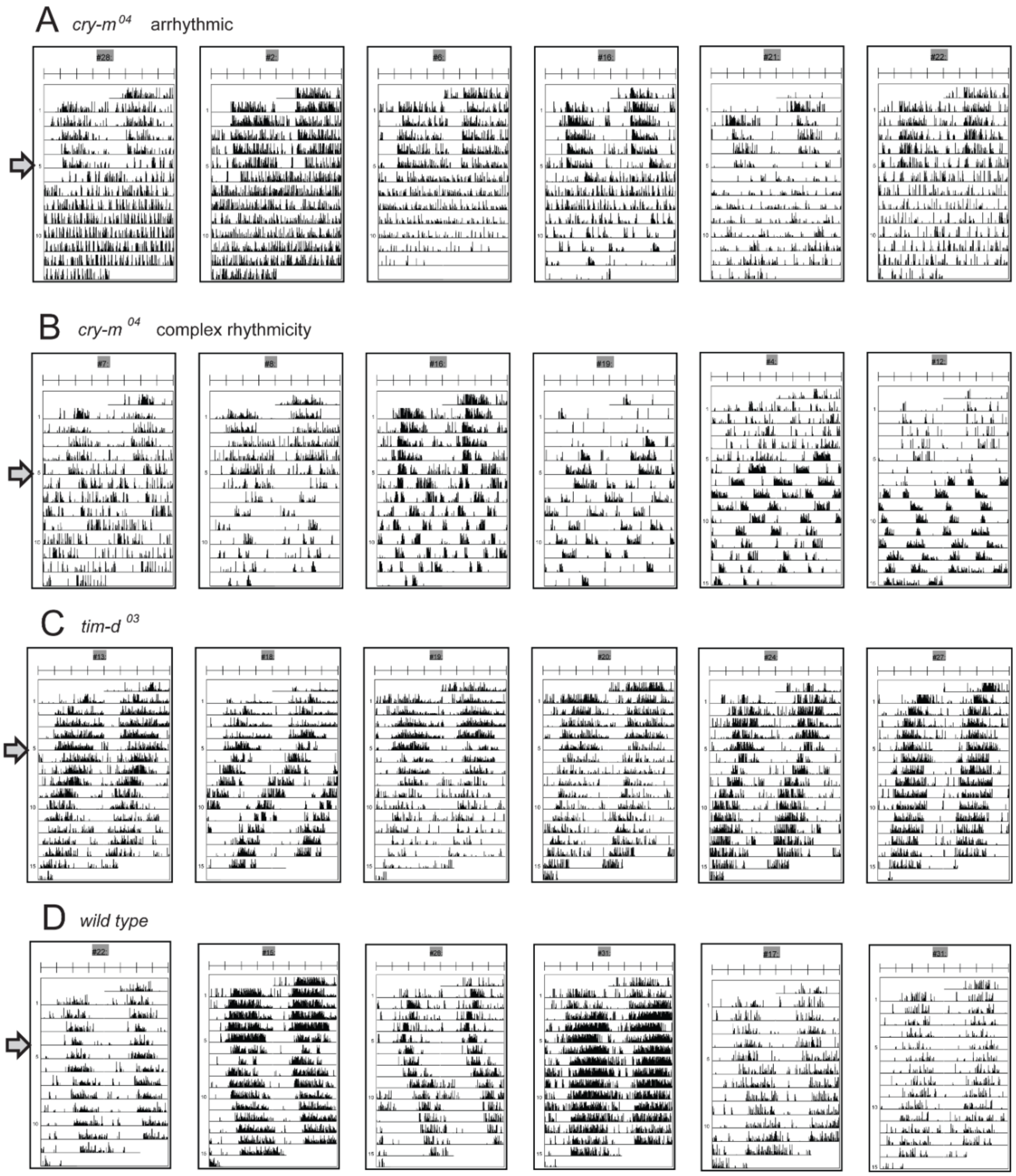
Supplementary Figure 12. A detailed summary of the free-running period (τ) in the wild-type and genetic mutants. (*A*) Summary indicating number and phenotypes of measured mutant and heterozygous animals compared to their corresponding wild-type control siblings (labelled as 'ctrl. *cry-m*' and 'ctrl. *per, tim-d*', respectively). The statistical difference from the controls is shown as a p-value. (*B*) Individual τ values are plotted as a dot for each male, red bars depict means ± SEMs (values shown in parenthesis if <10 % of individuals were rhythmic). (*C*) Individual τ values plotted for males that showed either multiple periodic components or the τ changed during the recording. (*D*) The strength of the rhythmicity in the 'strong rhythmicity' group is shown as the PN value and red bars depict mean. (*E*) The strength of the rhythmicity in the 'complex rhythmicity' group is shown as the PN value. Wild-type control siblings are plotted for each genotype separately in panels *A* and *E*).



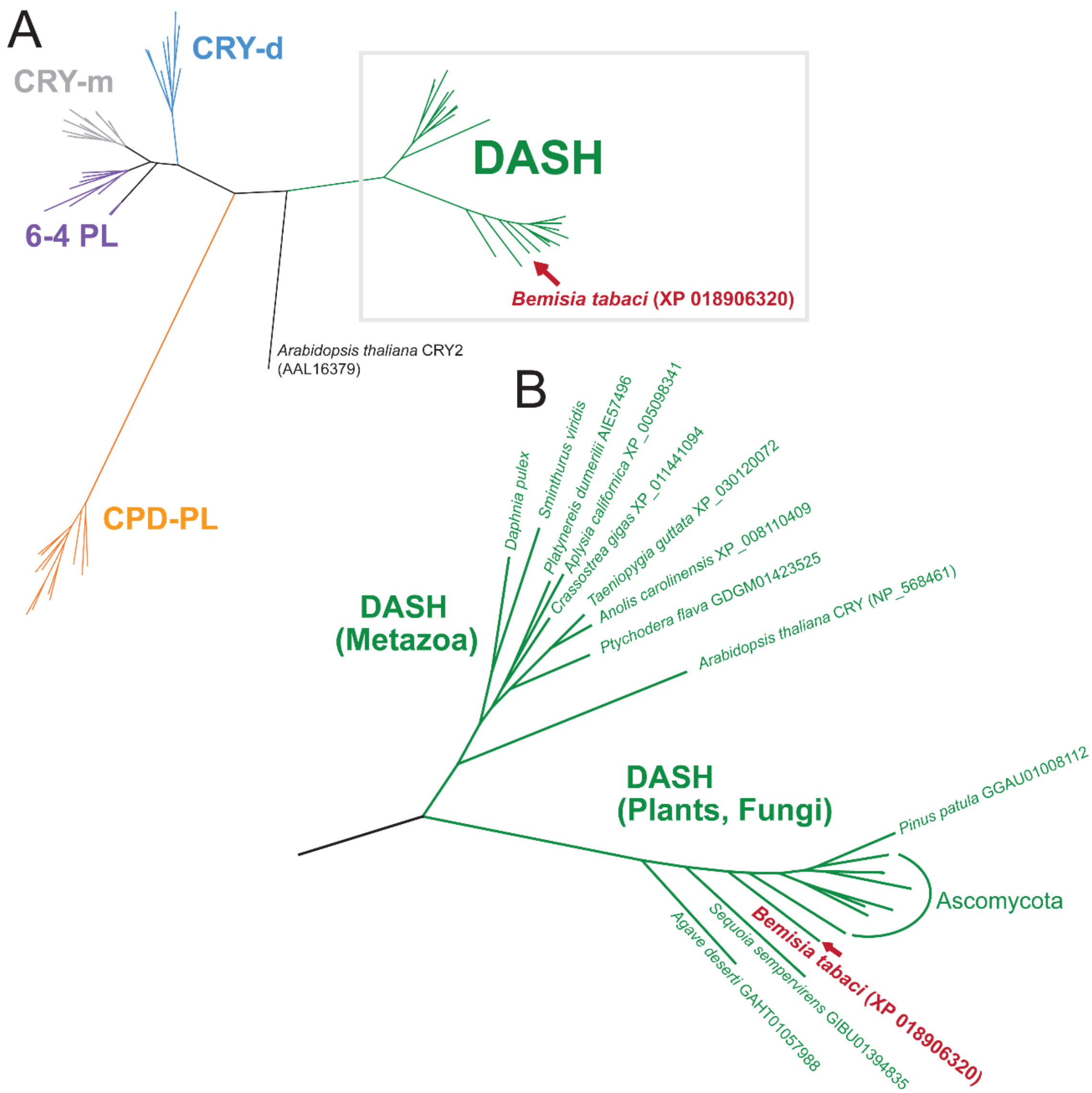
Supplementary Figure 13. TIM-d domains and protein alignment, part A. *P. apterus* TIM-d^{03} mutant protein sequence and six *P. apterus* wt TIM-d isoforms were aligned to *Drosophila* TIM-d (NP_001334730.1). Dashes (-) indicate gaps in the alignment, amino acids are color-coded according to their biochemical properties, and asterisks correspond to positions of a stop codons, which in mutant results in a premature termination of the TIM-d^{03} protein. Major functional domains were highlighted under *Drosophila* TIM-d together with important residues (indicated by grey arrows), whose mutations in *Drosophila* produce altered τ (33-36). L-TIM indicates N-terminal protein extension resulting from alternative translation start in *ls-tim* allele (37, 38). All major functional domains and key residues of TIM-d seem to be conserved in *P. apterus.*



Supplementary Figure 14. TIM-d domains and protein alignment, part B. The second part of the protein alignment depicting six *P. apterus* wt TIM-d isoforms aligned to *Drosophila* TIM-d (NP_001334730.1). Dashes (-) indicate gaps in the alignment, and amino acids are color-coded according to their biochemical properties. Major functional domains were highlighted under *Drosophila* TIM-d together with important residues (indicated by grey arrows), whose mutations in *Drosophila* produce altered τ (33, 36, 39, 40). All major functional domains and key residues of TIM-d seem to be conserved in *P. apterus.*



Supplementary Figure 15. Examples of *P. apterus* locomotor activity shown as double-plotted actogram. The activity of adult males was recorded at 25 ºC and light-dark cycles for five days. Then, males were released to constant-dark conditions (indicated by grey arrow). (*A*) Typical examples of arrhythmic *cry-m*^{04} homozygotes, (*B*) *cry-m*^{04} homozygotes with multiple periodic components, or the τ changed during the recording, (*C*) *tim-d*^{03} homozygotes, and (*D*) wild-type males are shown.



Supplementary Figure 16. Available *Bemisia tabaci* DASH-CRY sequence is highly suspicious. (*A*) Unrooted tree containing representative Metazoan CRYs, two *Arabidopsis thaliana* CRY proteins, *Bemisia tabaci* XP_018906320, and CRY proteins from plants and Ascomycota (Fungi) (66 protein sequences in total, RAxML, GAMMA-based Likelihood: -49344.467111). *B. tabaci* branches within DASH group, however, (*B*) Detailed inspection points to its clear relatedness to plant and fungal CRYs. Although horizontal gene transfer from plant or fungi to *Bemisia* cannot be excluded, the cross-contamination seems to be the most parsimonious explanation for the origin of the sequence.

Supplementary Materials and Methods

Animal model

Linden bugs, *Pyrrhocoris apterus*, were reared at 25 ± 0.5 °C under diapause-preventing long photoperiod of 18 h light and 6 h dark with access to linden seeds (*Tilia cordata*) and water *ad libitum*. The majority of experiments (RNA interference, CRISPR/Cas9 gene-editing of *per* and *tim-d* genes) were performed on Roana strain, whereas Oldrichovec strain was used for *cry-m* gene editing. See (1) for details of the strain's origin.

Circadian clock gene discovery in *Pyrrhocoris apterus*

Circadian clock gene homologs were identified in *P. apterus* in-house Illumina-based brain transcriptomes using the BLAST algorithm in the Geneious Prime 21.0.3 program (Biomatters, New Zealand, https://www.geneious.com/). As queries, protein sequences of circadian clock genes from *Drosophila melanogaster* and mouse were used. The full-length sequences were confirmed, and alternatively-spliced isoforms were identified in full-cDNA sequences obtained by Oxford Nanopore Technology (Oxford Nanopore, Oxford, UK) from male and female brains. These curated transcriptomic data were further compared to the in-house *P. apterus* genome draft to define exons and introns. Sequences used in this study were uploaded to GenBank (see Table S3 for accession numbers). The entire *P. apterus* genome and transcriptome will be published elsewhere. Putative functional domains in PER, TIM-d, and CRY-m were predicted on the homology to already established domains in *D. melanogaster* and mouse orthologs.

RNA interference (RNAi)

RNAi was performed as in (2-5). Briefly, two non-overlapping fragments located within the open reading frame of each gene were amplified using PCR (see Table S4 for the exact position of each fragment), cloned into pGEM-T Easy (Promega), and inserts were verified by Sanger sequencing. Templates for dsRNA *in-vitro* synthesis were prepared from pGEM-T Easy clones by PCR using M13 forward and pGEM-RNAi reverse 5'-TAATACGACTCACTATAGGGGACACTATAGAATACT-3' primer replacing SP6 to T7 promoter. Double-stranded RNA was synthesized using MEGAscript T7 transcription kit (Ambion/ThermoFisher) following the manufacturer's protocol. As a negative control, 178 bp long *beta-galactosidase* (*lacZ*) dsRNA was used. Adult males received 2 µl of dsRNA at a concentration of 4 mg/ml in Ringer's solution.

CRISPR/Cas9 gene editing

Details of *P. apterus* gene editing are described in (6), here is just a brief overview: 0-12 h after egg laying embryos were injected with gRNA/Cas9 mix. Early experiments (*cry-m* editing) were performed with *Cas9* mRNA, whereas the later experiments (*per* and *tim-d* editing) relied on CAS9 protein (CP01 from PNA Bio). After 8-9 days, hatched larvae were transferred to a Petri dish supplied with water and linden seeds and allowed to grow until adulthood (G0 adults). Adults were mated to wild-type and, after first batches of eggs were laid, their gonads were dissected. PCR heteroduplex mobility assay was used to assess levels of mosaicism in gonads, and only the offspring from animals with the highest level of mosaicism were kept. In the next generation, individuals with successfully modified genes were identified from antennal-squish PCR.

Seven to nine generations of backcrosses to wt strain (~one year of backcrossing) were used to outcross possible off-target modifications. To further dissect the impact of the engineered mutation from an off-target effect and the bottleneck effect of these backcrosses, the following protocol was applied: heterozygotes were crossed together, and their adult male progeny (which consisted of the mixture of wt, heterozygotes, and homozygotes) were used to perform locomotor activity run. After the run ended and analyses of the behavior were performed, individuals were genotyped by PCR.

<u>Locomotor activity recording and analysis</u>

In all experiments, adult males were used for locomotor activity analysis. Bugs were individually housed in the test tubes (2.5 cm diameter, 15 cm in length) supplemented *ad libitum* with dry linden seeds and water and placed in the Locomotor Activity Monitors (LAM 25, TriKinetics Inc., Waltham, MA, USA). All activity measurements were performed in the Cooled Incubator MIR-154 (Sanyo/Panasonic, Japan) equipped with a built-in electronic timer, where bugs were synchronized for 5 days in LD conditions (18 h light, 6 h darkness) at 25 °C, followed by at least 10 days in constant darkness (DD) at 25 °C. The locomotor activity of *P. apterus* was recorded automatically in 5-min bins.

Males injected with dsRNA and their controls (intact males and males injected with *lacZ* dsRNA) were immediately placed in the Locomotor Activity Monitors. To evaluate the impact of CRISPR/Cas9-induced mutations, 2-5 day after adult ecdysis male siblings (wt, heterozygotes, and homozygotes; see the ‘CRISPR/Cas9 gene editing’ section for details) were run in parallel.

To determine rhythmicity and τ in the constant darkness, the Lomb-Scargle periodogram in ActogramJ plugin of ImageJ (7) was employed to analyze activity from 10 consecutive days in DD. In the case of *tim-m* knockdowns, we also analyzed days 1-5 and days 6-10 separately. All actograms were further inspected by an independent investigator, who was not aware of the genotype. To describe *P. apterus* behavior in DD, three categories were defined following the description in (1): 1) strong rhythm, if the PN value of the periodogram (significance level of the periodogram) crossed significance threshold and actogram passed visual inspection test; 2) complex rhythm, if multiple periodic components were identified, or if the τ changed during the recording; 3) arrhythmic, if the PN value did not reach significance threshold or actogram did not pass visual inspection test.

The statistical analysis of the differences in τ was performed using Kruskal–Wallis test with Dunn's post-hoc test using Prism 7 (GraphPad Software, La Jolla, CA, USA). RNAi males were compared to corresponding controls, intact and ds*lacZ*, whereas homozygous mutants were compared to their heterozygous and wt siblings (see the CRISPR/Cas9 gene-editing section for explanation).

<u>Phylogenetic analyses</u>

A systematic search for circadian clock genes in Metazoa was performed in GenBank (NCBI) protein and genomic databases, and in transcriptome shotgun assemblies (TSA) using BLAST-P and tBLASTn algorithms, respectively, with taxon limits for searches in particular lineages at the level of orders, suborders, infraorders, and species. In some cases, the genome or whole-genome shotgun contigs (wgs) were explored. As queries, protein sequences of circadian clock genes from *D. melanogaster*, mouse, and *P. apterus* were used. To identify precisely the type of CRY (-m, -d, 6-4 photolyase, CPD photolyase, or DASH) (8-11), TIM (-d or -m) (12), and PER (PER1, PER2, or PER3), protein sequences were aligned using MAFFT algorithm (13) in Geneious Prime 21.0.3 (Biomatters, New Zealand), unambiguously aligned regions were trimmed and phylogenetic analysis was performed using RAxML version 8.2.11 (14) in Geneious Prime 21.0.3 (Biomatters, New Zealand). Final figure illustration additions, such as the description of taxa, were performed in Illustrator CS5 (Adobe).

The Metazoan phylogeny shown in Fig. 2 is a consensus of recent molecular phylogenomic studies; namely those focused on insects (15), chelicerates, and arthropods (16), mollusks (17), vertebrates (18), protostomian/deuterostomian split (19). Within the richest group, insects, phylogenomic studies focused on Polyneoptera (20), Blattodea (21), hemipteroid assembly (22), Hymenoptera (23), Coleoptera (24), and Lepidoptera (25), were used as a reference for the corresponding part of the tree depicting the metazoan phylogeny.

Extended description of the Circadian Clock Gene Phylogeny

<u>Phylogeny and evolution of circadian clock genes in Metazoa</u>

The remarkable recent progress in Metazoan phylogenomics, the amount of TSA data, and a growing number of sequenced genomes allowed us to explore the circadian clock genes systematically across all major Metazoan groups. Here, we focus on lineage-specific gene losses which are well supported from multiple species, whole-genome assemblies, and deep sequencing of the entire transcriptomes. These losses are also highlighted in Fig. 2 of the study and summarized in Table S2.

PERIOD

PER protein-coding sequences were identified in all Metazoan species with the exception of one basal deuterostomian lineage consisting of Echinodermata and Hemichordata. The phylum Echinodermata, with starfish, sea urchins, and sea cucumbers, contains several species with well-sequenced genomes, including the purple sea urchin *Strongylocentrotus purpuratus* (26) and the crown-of-thorns starfish *Acanthaster planci* (27). The genome of hemichordates is also available (28). Given the reasonable quality of these genomes, and the solid amount of TSA data, the absence of *per* in those two phyla is the most parsimonious explanation. Gene multiplication was observed in all vertebrates leading to three *period* gene paralogs, albeit reduced to only two of them in some lineages.

TIMELESS

Two TIM paralogs, TIM-d (the *Drosophila*-type) and TIM-m (the mammalian-type) exist in Metazoa (12). The phylogenetic analysis undoubtedly separated them into two clusters (Fig. S3). TIM-m is present in all analyzed organisms consistently with its essential role in development (29, 30). TIM-d is present in both Deuterostomia and Protostomia, however, three apparent gene losses were identified in: (*i*) Chordata, a lineage containing the lancelet *Branchiostoma* (Cephalochordata), the lamprey *Petromyzon* (Cyclostomata), and vertebrates; (*ii*) termites, with the exception of one basal termite species *Porotermes*; and (*iii*) Hymenoptera, an order containing wasps, bees, ants, and bumblebees. In all three cases, the gene loss is supported by multiple well-assembled genomes.

JETLAG (JET)

JET, a protein responsible for degradation of TIM-d and CRY-d is reliably identifiable in Protostomia, where it was lost several times in (*i*) Cimicomorpha and Pentatomorpha, two large heteropteran groups, (*ii*) in aphids, (*iii*) Psocodea, a group containing lice, (*iv*) Hymenoptera, (*v*) Neuropterida, and (*vi*) crown Coleoptera, including the red flour beetle *Tribolium castaneum*. In Deuterostomia, we identified FBXL15 as proteins similar in sequence to JET and branching at the base of the protostomian JET cluster, thus, we refer to them as JET-like.

FBXL 3/21 proteins

FBXL3 and FBXL21 are two closely related CRY-m-interacting vertebrate paralogs (13, 31, 32) that result from genome duplication, which took place in the ancestor of all known vertebrates. Thus, the original protein-coding gene is described as *FBXL3/21*. *FBXL3/21* was lost in: (*i*) mollusks and annelids, (*ii*) hemipteroid assembly (Heteroptera, Auchenorrhyncha, Sternorrhyncha), that is a large group containing true bugs, cicadas, planthoppers, aphids, psyllids, etc., (*iii*) Psocodea, (*iv*) and Holometabola except for Hymenoptera, where the sequence is well conserved (Fig. S2 panels B and D).

CRYPTOCHROMES

Metazoan CRYPTOCHROMES and PHOTOLYASES can be organized into five groups: CRY-d known as the *Drosophila*-type, CRY-m known from the mammalian clock, 6-4 PHOTOLYASE (6-4 PL), CPD PHOTOLYASE (CPD-PL), which is also known in *Drosophila* as PHOTOREPAIR, and DASH (*Drosophila*, *Arabidopsis*, *Synechocystis*, *Human*)-type CRY. Although the sequences can reliably be assigned to a specific group reflecting its origin, the phylogenetic relationship does not guarantee the protein still possesses specific biochemical properties.

CRY-d was lost: (*i*) in all chordates (but is present in basal deuterostomian lineage, Echinodermata and Hemichordata), (*ii*) in the subset of Blattodea containing all termites and three roach families: Cryptocercidae, Lamproblattidae, and Blattidae. (*iii*) In Cimicomorpha and Pentatomorpha, two large heteropteran groups, (*iv*) parasitic lice, (*v*) Hymenoptera, and (*vi*) crown Coleoptera (beetles).

CRY-m was only lost in Cyclorrhapha, a crown group of Diptera.

6-4 PL forms a sister group to CRY-m and was lost in: (*i*) mammals, (*ii*) Cephalopoda (squids, octopuses), (*iii*) all Blattodea (cockroaches and termites), (*iv*) all Heteroptera, (*v*) parasitic lice, (*vi*) Hymenoptera, and (*vii*) crown Coleoptera. 6-4 PL was independently duplicated in the lancelet *Branchiostoma* and vertebrates, where it was reduced to one copy in birds and lost in mammals.

CPD PL was lost in: (*i*) placental mammals, (*ii*) termites and sister group Cryptocercidae, (*iii*) parasitic lice, (*iv*) and crown Coleoptera.

DASH was lost in: (*i*) mammals, (*ii*) cephalopods, (*iii*) chelicerates, (*iv*) and all insects. Although we were able to find a DASH-like sequence in *Bemisia*. However, its detailed phylogenetic reconstruction indicates the sequence is branching among DASH of plants and fungi, thus we probably witness sample contamination, which is in a plant-sucking insect fairly conceivable option. However, we cannot rule out a horizontal gene transfer at this point, albeit it is an unlikely explanation.

P. apterus timeless gene structure and its alternatively spliced isoforms

In *P. apterus tim-d*, the deletion was engineered within the 7^{th} exon, resulting in a frameshift followed by a premature stop codon. The only alternative splicing of *tim-d* was detected in downstream exons 9, 17, and 18 (Fig. 4A and Figs. S13 and S14), with the engineered deletion itself not affecting the splicing of exons 7 and 8 (Fig. S8). Therefore, *tim-d*^{03} encodes only the initial one-third of the TIM-d protein lacking the evolutionarily conserved PER-interaction regions, nuclear localization signal, and several key amino acid residues downstream (Fig. 4A, Figs. S13 and S14). These features, essential for its proper function in *Drosophila*, are remarkably conserved also in *P. apterus* TIM-d.

Supplementary Table 1. Circadian clock gene homologs identified in Metazoa (graphically depicted in Fig. 2)

Species/group	gene, cDNA, or protein	acc #	note
Drosophila melanogaster Metazoa; Arthropoda; Insecta; Holometabola; Diptera; Brachycera; Cyclorrhapha; Drosophilidae	*cryptochrome-d*	4JZY_A	
	cryptochrome-m	--	Absent in the genome
	6-4 photolyase	NP_001260632	
	CPD photolyase	NP_724613	
	DASH	--	
	timeless-d	AAC46920	
	timeless-m	NP_524341	
	period	AAA28752	
	jetlag	ABF57911	
	FBXL3/21	--	Absent in the genome
Musca domestica Metazoa; Arthropoda; Insecta; Holometabola; Diptera; Brachycera; Cyclorrhapha, Muscidae	*cryptochrome-d*	XP_019890502	
	cryptochrome-m	--	
	6-4 photolyase	XP_005182773	
	CPD photolyase	GARN01046938	
	DASH	--	
	timeless-d	AFP61060	
	timeless-m	XP_005185938	
	period	AAD39163	
	jetlag	XP_005176477	
	FBXL3/21	--	Absent in the genome
Ceratitis capitata Metazoa; Arthropoda; Insecta; Holometabola; Diptera; Brachycera; Cyclorrhapha, Tephritidae	*cryptochrome-d*	XP_004529289	
	cryptochrome-m	--	
	6-4 photolyase	XP_004531295	
	CPD photolyase	XP_004535731	
	DASH	--	
	timeless-d	JAB93858	
	timeless-m	XP_023158675; XP_023158519	partial sequence
	period	ABB20914	
	jetlag	CAD6999318	
	FBXL3/21	--	Not found in the TSA
Heteropsilopus ingenuus Metazoa; Arthropoda; Insecta; Holometabola; Diptera; Brachycera;	*cryptochrome-d*	GCGO01027349	
	cryptochrome-m	GCGO01039126	partial sequence
	6-4 photolyase	GCGO01026479	partial sequence
	CPD photolyase	GCGO01028698	partial sequence
	DASH	--	
	timeless-d	GCGO01029282	

Eremoneura; Dolichopodidae	*timeless-m*	GCGO01016606	partial sequence
	period	GCGO01031901	partial sequence
	jetlag	GCGO01024636	
	FBXL3/21	--	Not found in the TSA
Machimus arthriticus Metazoa; Arthropoda; Insecta; Holometabola; Diptera; Brachycera; Asiloidea; Asilidae	*cryptochrome-d*	GFFZ01008305	
	cryptochrome-m	GFFZ01012401	
	6-4 photolyase	--	
	CPD photolyase	GFFZ01009761	
	DASH	--	
	timeless-d	GFFZ01001760	
	timeless-m	GFFZ01000199; GFZQ01002839; GFZQ01020989	3 partial fragments
	period	GFFZ01021722	
	jetlag	GFZQ01008008	
	FBXL3/21	--	Not found in the TSA
Bombylius major Metazoa; Arthropoda; Insecta; Holometabola; Diptera; Brachycera; Asiloidea; Bombyliidae	*cryptochrome-d*	--	Not found in the TSA
	cryptochrome-m	GATI02019140	
	6-4 photolyase	GATI02019132	
	CPD photolyase	GATI02014885; GATI02016082	2 partial fragments
	DASH	--	
	timeless-d	GATI02019706; GATI02016907; GATI02009616; GATI02009555	4 partial fragments
	timeless-m	GATI02002591; GATI02005167; GATI02012230; GATI02014497	4 partial fragments
	period	GATI02019485	
	jetlag	--	Not found in the TSA
	FBXL3/21	--	Not found in the TSA
Culex quinquefasciatus Metazoa; Arthropoda; Insecta; Holometabola; Diptera; Nematocera; Culicidae	*cryptochrome-d*	XP_001851403	
	cryptochrome-m	AXG24360	
	6-4 photolyase	XP_001867895	
	CPD photolyase	XP_001845657	
	DASH	--	
	timeless-d	XP_001848611	
	timeless-m	XP_001842224	
	period	AKE07650	
	jetlag	CPIJ015883-RA	
	FBXL3/21	--	Not found in the TSA
Anopheles gambiae Metazoa; Arthropoda; Insecta; Holometabola;	*cryptochrome-d*	XP_321104	
	cryptochrome-m	ABB29887	
	6-4 photolyase	XP_314748	
	CPD photolyase	XP_313925	
	DASH	--	

Diptera; Nematocera; Culicidae	*timeless-d*	XP_001689006	
	timeless-m	XP_001689129	
	period	GIBN01001963	
	jetlag	XP_310005	
	FBXL3/21	--	Not found in the TSA
Bombyx mori Metazoa; Arthropoda; Insecta; Holometabola; Lepidoptera; Ditrysia; Bombycidae	*cryptochrome-d*	NP_001182628	
	cryptochrome-m	NP_001182627	
	6-4 photolyase	GFCY01030226	
	CPD photolyase	XP_004930027	
	DASH	--	
	timeless-d	NP_001037622	
	timeless-m	XP_004925203	
	period	XP_021205994	
	jetlag	XP_012543943	
	FBXL3/21	--	Not found in the TSA or genome
Danaus plexippus Metazoa; Arthropoda; Insecta; Holometabola; Lepidoptera; Ditrysia; Nymphalidae	*cryptochrome-d*	OWR41136	
	cryptochrome-m	OWR50781	
	6-4 photolyase	ABO38436	
	CPD photolyase	XP_032529216	
	DASH	--	
	timeless-d	XP_032510676	
	timeless-m	XP_032512746	
	period	XP_032527423	
	jetlag	XP_032519306	
	FBXL3/21	--	Not found in the TSA or genome
Palaephatus luteolus Metazoa; Arthropoda; Insecta; Holometabola; Lepidoptera; Palaephatoidea; Palaephatidae	*cryptochrome-d*	GEON01018930	
	cryptochrome-m	GENI01028497	
	6-4 photolyase	GENI01143689	
	CPD photolyase	GEON01022982	
	DASH	--	
	timeless-d	GENI01053289	
	timeless-m	GEON01026825	
	period	GEON01019583	
	jetlag	GEON01009399	
	FBXL3/21	--	Not found in the TSA
Psychomyia flavida Metazoa; Arthropoda; Insecta; Holometabola; Trichoptera; Psychomyiidae	*cryptochrome-d*	GDSC01031720	
	cryptochrome-m	GDSC01027636	
	6-4 photolyase	GDSC01002868	
	CPD photolyase	GDSC01034993	
	DASH	--	
	timeless-d	GDSC01005764	
	timeless-m	GDSC01034894	
	period	GDSC01030560	

	jetlag	--	Not found in the TSA
	FBXL3/21	--	Not found in the TSA
Corydalus cornutus Metazoa; Arthropoda; Insecta; Holometabola; Megaloptera; Corydalidae	*cryptochrome-d*	GATG02017634	
	cryptochrome-m	GATG02013625	
	6-4 photolyase	GATG02016608	partial sequence
	CPD photolyase	GATG02012842	
	DASH	--	
	timeless-d	GATG02015528; GATG02017314	2 partial fragments
	timeless-m	GATG02005567; GATG02010398; GATG02005981	3 partial fragments
	period	GATG02014479	
	jetlag	--	Not found in the TSA
	FBXL3/21	--	Not found in the TSA
Conwentzia psociformis Metazoa; Arthropoda; Insecta; Holometabola; Neuroptera; Coniopterygidae	*cryptochrome-d*	GAYH02027555	
	cryptochrome-m	GAYH02030033	
	6-4 photolyase	GAYH02021873	
	CPD photolyase	GAYH02012585	
	DASH	--	
	timeless-d	GATG02015528; GATG02017314	2 partial fragments
	timeless-m	GAYH02012647; GAYH02012108	2 partial fragments
	period	GAYH02013843	
	jetlag	--	Not found in the TSA
	FBXL3/21	--	Not found in the TSA
Xanthostigma xanthostigma Metazoa; Arthropoda; Insecta; Holometabola; Raphidioptera; Raphidiidae	*cryptochrome-d*	--	Not found in the TSA
	cryptochrome-m	GAUI02044449	
	6-4 photolyase	GAUI02043242	
	CPD photolyase	GAUI02012114; GAUI02012911	2 partial fragments
	DASH	--	
	timeless-d	GAUI02033942	partial fragment
	timeless-m	GAUI02050009	
	period	GAUI02046259	
	jetlag	--	Not found in TSA
	FBXL3/21	--	Not found in TSA
Tribolium castaneum Metazoa; Arthropoda; Insecta; Holometabola; Coleoptera; Polyphaga; Tenebrionidae	*cryptochrome-d*	--	Not found in the genome, transcriptome, or TSA
	cryptochrome-m	EFA04537	
	6-4 photolyase	--	Not found in the genome,

			transcriptome, or TSA
	CPD photolyase	--	Not found in the genome, transcriptome, or TSA
	DASH	--	
	timeless-d	XP_008192983	
	timeless-m	XP_008201051	
	period	XP_015835617	
	jetlag	--	Not found in the genome, transcriptome, or TSA
	FBXL3/21	--	Not found in the genome, transcriptome, or TSA
Onthophagus taurus Metazoa; Arthropoda; Insecta; Holometabola; Coleoptera; Polyphaga; Scarabaeidae	*cryptochrome-d*	--	
	cryptochrome-m	XP_022918997	
	6-4 photolyase	--	
	CPD photolyase	--	
	DASH	--	
	timeless-d	XP_022903307	
	timeless-m	XP_022919507	
	period	XP_022899891	
	jetlag	--	Not found in TSA
	FBXL3/21	--	Not found in TSA
Agrilus planipennis Metazoa; Arthropoda; Insecta; Holometabola; Coleoptera; Polyphaga; Buprestidae	*cryptochrome-d*	XP_025837056	
	cryptochrome-m	XP_018331212	
	6-4 photolyase	XP_018321940	
	CPD photolyase	XP_018319593	
	DASH	--	
	timeless-d	GDOC01018042	
	timeless-m	XP_018327682	
	period	XP_025836066	
	jetlag	XP_018321770	
	FBXL3/21	--	Not found in the TSA
Pogonus chalceus Metazoa; Arthropoda; Insecta; Holometabola; Coleoptera; Adephaga; Carabidae	*cryptochrome-d*	JU432971	
	cryptochrome-m	JU410080	
	6-4 photolyase	JU430199	
	CPD photolyase	JU423416	
	DASH	--	
	timeless-d	JU426733; JU418895	2 partial fragments
	timeless-m	JU429343	
	period	JU419193	
	jetlag	JU405152	

	FBXL3/21	--	Not found in the TSA
Haliplus fluviatilis Metazoa; Arthropoda; Insecta; Holometabola; Coleoptera; Adephaga; Haliplidae	*cryptochrome-d*	GDMW01041568	
	cryptochrome-m	GDMW01034020	
	6-4 photolyase	GDMW01027856	
	CPD photolyase	GDMW01027923	
	DASH	--	
	timeless-d	GDMW01027768; GDMW01036386	2 partial fragments
	timeless-m	GDMW01027750	
	period	GDMW01032314; GDMW01022608	2 partial fragments
	jetlag	GDMW01045097	
	FBXL3/21	--	Not found in TSA
Apis mellifera Metazoa; Arthropoda; Insecta; Holometabola; Hymenoptera; Apocrita; Aculeata; Apoidea; Apidae	*cryptochrome-d*	--	Not found in the genome, transcriptome, or TSA
	cryptochrome-m	ABO38437	
	6-4 photolyase	--	Not found in the genome, transcriptome, or TSA
	CPD photolyase	XP_006564509	
	DASH	--	Not found in the genome, transcriptome, or TSA
	timeless-d	--	Not found in the genome, transcriptome, or TSA
	timeless-m	XP_006565496	
	period	ARB43935	
	jetlag	--	Not found in the genome, transcriptome, or TSA
	FBXL3/21	XP_006565259	
Nasonia vitripennis Metazoa; Arthropoda; Insecta; Holometabola; Hymenoptera; Apocrita; Parasitoidea; Chalcidoidea; Pteromalidae	*cryptochrome-d*	--	Not found in the genome, transcriptome, or TSA
	cryptochrome-m	XP_001606405	
	6-4 photolyase	--	Not found in the genome, transcriptome, or TSA
	CPD photolyase	XP_016844206	

	DASH	--	Not found in the genome, transcriptome, or TSA
	timeless-d	--	Not found in the genome, transcriptome, or TSA
	timeless-m	XP_031783081	
	period	XP_016844400	
	jetlag	--	Not found in the genome, transcriptome, or TSA
	FBXL3/21	XP_008205714	
Orussus abietinus Metazoa; Arthropoda; Insecta; Holometabola; Hymenoptera; Orussoidea; Orussidae	*cryptochrome-d*	--	
	cryptochrome-m	XP_012284947	
	6-4 photolyase	--	
	CPD photolyase	XP_012272812	
	DASH	--	
	timeless-d	--	
	timeless-m	XP_012279584	
	period	XP_023290616	
	jetlag	--	Not found in the TSA
	FBXL3/21	XP_012281024	
Athalia rosae Metazoa; Arthropoda; Insecta; Holometabola; Hymenoptera; Tenthredinoidea; Tenthredinidae	*cryptochrome-d*	--	
	cryptochrome-m	XP_012266148	
	6-4 photolyase	--	
	CPD photolyase	XP_012254557	
	DASH	--	
	timeless-d	--	
	timeless-m	XP_020709520	
	period	XP_012265524	
	jetlag	--	Not found in the TSA
	FBXL3/21	XP_012263772	
Cerobasis guestfalica Metazoa; Arthropoda; Insecta; Paraneoptera; Psocodea; Psocoptera, Trogiidae	*cryptochrome-d*	GDEA01029438	
	cryptochrome-m	GDEA01042853	
	6-4 photolyase	GDEA01039570	
	CPD photolyase	GDEA01047900	
	DASH	--	
	timeless-d	GDEA01045279	
	timeless-m	GCWJ01017645; GDEA01020989, GDEA01028135	3 partial fragments
	period	GDEA01042435	
	jetlag	--	Not found in the TSA
	FBXL3/21	--	Not found in the TSA

Heterocaecilius solocipennis Metazoa; Arthropoda; Insecta; Paraneoptera; Psocodea; Psocoptera, Pseudocaeciliidae	*cryptochrome-d*	GDEU01005874, GDEU01000308	2 partial fragments
	cryptochrome-m	GDEU01008438	
	6-4 photolyase	GDEU01006910	
	CPD photolyase	GDEU01029020	
	DASH	--	
	timeless-d	GDEU01008518	
	timeless-m	GDEU01008713	
	period	GDEU01008592	
	jetlag	--	Not found in the TSA
	FBXL3/21	--	Not found in the TSA
Peripsocus phaeopterus Metazoa; Arthropoda; Insecta; Paraneoptera; Psocodea; Psocoptera, Peripsocidae	*cryptochrome-d*	GDDU01009455	
	cryptochrome-m	GDDU01009332	
	6-4 photolyase	GDDU01010248	
	CPD photolyase	GDDU01022857	
	DASH	--	
	timeless-d	GDDU01010920; GDDU01007930; GDDU01005991	3 partial fragments
	timeless-m	GDDU01022229; GDDU01008138	2 partial fragments
	period	GDDU01011596	
	jetlag	--	Not found in the TSA
	FBXL3/21	--	Not found in the TSA
Lachesilla contraforcepeta Metazoa; Arthropoda; Insecta; Paraneoptera; Psocodea; Psocoptera, Lachesillidae	*cryptochrome-d*	GCWJ01017645	
	cryptochrome-m	GCWJ01022319	
	6-4 photolyase	GCWJ01026396	
	CPD photolyase	GCWJ01019774	
	DASH	--	
	timeless-d	GCWJ01021271	
	timeless-m	GCWJ01024943	
	period	GCWJ01026302	
	jetlag	--	Not found in the TSA
	FBXL3/21	--	Not found in the TSA
Craspedorrhynchus sp. Metazoa; Arthropoda; Insecta; Paraneoptera; Psocodea; Phthiraptera; Philopteridae	*cryptochrome-d*	--	
	cryptochrome-m	GCWN01038461	
	6-4 photolyase	--	
	CPD photolyase	--	
	DASH	--	
	timeless-d	GCWN01015667	
	timeless-m	GCWN01030588	
	period	GCWN01026715	

	jetlag	--	Not found in the TSA
	FBXL3/21	--	Not found in the TSA
Columbicola columbae Metazoa; Arthropoda; Insecta; Paraneoptera; Psocodea; Phthiraptera; Philopteridae	*cryptochrome-d*	--	
	cryptochrome-m	GCWB01035766	
	6-4 photolyase	--	
	CPD photolyase	--	
	DASH	--	
	timeless-d	GCWB01033489	
	timeless-m	GCWB01038026	
	period	GCWB01036402	
	jetlag	--	Not found in the TSA
	FBXL3/21	--	Not found in the TSA
Pediculus humanus Metazoa; Arthropoda; Insecta; Paraneoptera; Psocodea; Phthiraptera; Pediculidae	*cryptochrome-d*	--	
	cryptochrome-m	XP_002430545	
	6-4 photolyase	--	
	CPD photolyase	--	
	DASH	--	
	timeless-d	EEB19683	
	timeless-m	EEB13198	
	period	XP_002426301	
	jetlag	--	Not found in the genome, transcriptome, or TSA
	FBXL3/21	--	Not found in the genome, transcriptome, or TSA
Frankliniella occidentalis Metazoa; Arthropoda; Insecta; Paraneoptera; Thysanoptera; Thripidae	*cryptochrome-d*	GCYR01014055	
	cryptochrome-m	GAXD01023628	
	6-4 photolyase	GCYR01020055	
	CPD photolyase	KAE8748624	
	DASH	--	
	timeless-d	XP_026280944	
	timeless-m	XP_026294102	
	period	XP_026278055	
	jetlag	XP_026275107	
	FBXL3/21	XP_026283316	
Orothrips kelloggi Metazoa; Arthropoda; Insecta; Paraneoptera; Thysanoptera; Aelothripidae	*cryptochrome-d*	GCXT01021188	
	cryptochrome-m	GCXT01026378	
	6-4 photolyase	GCXT01023161	
	CPD photolyase	GCXT01015659	
	DASH	--	
	timeless-d	GCXT01027714	

	timeless-m	GCXT01022059	
	period	GCXT01018680	
	jetlag	GCXT01014931	
	FBXL3/21	GCXT01014269	Partial sequence
Halyomorpha halys Metazoa; Arthropoda; Insecta; Paraneoptera; Hemiptera; Heteroptera; Pentatomomorpha; Pentatomidae	*cryptochrome-d*	--	Not found in the genome, transcriptome, or TSA
	cryptochrome-m	XP_014279454	
	6-4 photolyase	--	Not found in the genome, transcriptome, or TSA
	CPD photolyase	XP_014272968	
	DASH	--	Not found in the genome, transcriptome, or TSA
	timeless-d	XP_014278196	
	timeless-m	XP_024217293	
	period	XP_014285208	
	jetlag	--	Not found in the genome, transcriptome, or TSA
	FBXL3/21	--	Not found in the genome, transcriptome, or TSA
Cimex lectularius Metazoa; Arthropoda; Insecta; Paraneoptera; Hemiptera; Heteroptera; Cimicomorpha; Cimicidae	*cryptochrome-d*	--	Not found in the genome, transcriptome, or TSA
	cryptochrome-m	XP_014255347	
	6-4 photolyase	--	Not found in the genome, transcriptome, or TSA
	CPD photolyase	XP_014256100	
	DASH	--	Not found in the genome, transcriptome, or TSA
	timeless-d	XP_014260027	
	timeless-m	XP_014246467	
	period	XP_014250731	
	jetlag	--	Not found in the genome, transcriptome, or TSA

	FBXL3/21	--	Not found in the genome, transcriptome, or TSA
Rhodnius prolixus Metazoa; Arthropoda; Insecta; Paraneoptera; Hemiptera; Heteroptera; Cimicomorpha; Reduviidae	*cryptochrome-d*	--	Not found in the genome, transcriptome, or TSA
	cryptochrome-m	GECK01083311	
	6-4 photolyase	--	Not found in the genome, transcriptome, or TSA
	CPD photolyase	GECK01013387	
	DASH	--	Not found in the genome, transcriptome, or TSA
	timeless-d	GECK01071020	
	timeless-m	GECK01068203	
	period	GECK01038303	
	jetlag	--	Not found in the genome, transcriptome, or TSA
	FBXL3/21	--	Not found in the genome, transcriptome, or TSA
Trichocorixa calva Metazoa; Arthropoda; Insecta; Paraneoptera; Hemiptera; Heteroptera; Nepomorpha; Corixidae	*cryptochrome-d*	GCYZ01037595	
	cryptochrome-m	GCYZ01040330	
	6-4 photolyase	--	Not found in the TSA
	CPD photolyase	GCYZ01037238	
	DASH	--	Not found in the TSA
	timeless-d	GCYZ01029016	
	timeless-m	GCYZ01027556	
	period	GCYZ01025514	
	jetlag	GCYZ01034783	
	FBXL3/21	--	Not found in the TSA
Rhagovelia antilleana Metazoa; Arthropoda; Insecta; Paraneoptera; Hemiptera; Heteroptera; Gerromorpha; Veliidae	*cryptochrome-d*	GFOS01101543	
	cryptochrome-m	GFOS01070464	
	6-4 photolyase	--	Not found in the genome, transcriptome, or TSA
	CPD photolyase	GFOS01110824	

	DASH	--	Not found in the genome, transcriptome, or TSA
	timeless-d	GFOS01032396	
	timeless-m	GFOS01100367	
	period	GFOS01044706	
	jetlag	GFOS01057713	
	FBXL3/21	--	Not found in the genome, transcriptome, or TSA
Homalodisca vitripennis Metazoa; Arthropoda; Insecta; Paraneoptera; Hemiptera; Aucheno-rrhyncha; Cicadomorpha; Cicadellidae	*cryptochrome-d*	GHXA01007521	
	cryptochrome-m	GHXA01008453	
	6-4 photolyase	GHXA01015203	
	CPD photolyase	GHXA01011277	
	DASH	--	Not found in the genome, transcriptome, or TSA
	timeless-d	GHXA01018537	
	timeless-m	GHXA01016937	
	period	GHXA01003322	
	jetlag	GICT01181535	
	FBXL3/21	--	Not found in the genome, transcriptome, or TSA
Bemisia tabaci Metazoa; Arthropoda; Insecta; Paraneoptera; Hemiptera; Sternorrhyncha; Aleyrodoidea; Aleyrodidae	*cryptochrome-d*	GEZK01146017	
	cryptochrome-m	GAUC01050840	
	6-4 photolyase	GEZK01161051	
	CPD photolyase	XP_018905815	
	DASH	XP_018906320	Plant/fungal contamination?
	timeless-d	XP_018904703	
	timeless-m	XP_018907854	
	period	18910230	
	jetlag	XP_018903799	
	FBXL3/21	--	Not found in the genome, transcriptome, or TSA
Pachypsylla venusta Metazoa; Arthropoda; Insecta; Paraneoptera; Hemiptera; Sternorrhyncha; Psylloidea; Aphalaridae	*cryptochrome-d*	GAOP01084163	
	cryptochrome-m	GAOP01061315	
	6-4 photolyase	GAOP01114724	
	CPD photolyase	GAOP01112348	
	DASH	--	Not found in the TSA
	timeless-d	GAOP01060320	
	timeless-m	GAOP01095293	

	period	GAOP01098646; GAOP01098647	2 partial fragments
	jetlag	GAOP01062272	
	FBXL3/21	--	Not found in TSA
Acyrthosiphon pisum Metazoa; Arthropoda; Insecta; Paraneoptera; Hemiptera; Sternorrhyncha; Aphidomorpha; Aphididae	*cryptochrome-d*	NP_001164532	
	cryptochrome-m	NP_001164572 ACYPI087167-PA	ACYPI087167-PA was retrieved from http://bf2i200.insa-lyon.fr:2555/; protein seq. seems to be only partial
	6-4 photolyase	XP_001946012	
	CPD photolyase	XP_001949151	
	DASH	--	Not found in the genome, transcriptome, or TSA
	timeless-d	ARM65417	
	timeless-m	XP_008186746	
	period	NP_001164576	
	jetlag	--	Not found in the genome, transcriptome, or TSA
	FBXL3/21	--	Not found in the genome, transcriptome, or TSA
Myzus persicae Metazoa; Arthropoda; Insecta; Paraneoptera; Hemiptera; Sternorrhyncha; Aphidomorpha; Aphididae	*cryptochrome-d*	XP_022178570	
	cryptochrome-m	AUN43314	
	6-4 photolyase	XP_022169149	
	CPD photolyase	XP_022172380	
	DASH	--	
	timeless-d	XP_022161049	
	timeless-m	XP_022179877	
	period	XP_022163849	
	jetlag	--	Not found in the TSA
	FBXL3/21	--	Not found in the TSA
Gryllus bimaculatus Metazoa; Arthropoda; Insecta; Polyneoptera; Orthoptera; Ensifera; Gryllidae	*cryptochrome-d*	BAX56238	
	cryptochrome-m	BAX56241	
	6-4 photolyase	GFMG01298695	
	CPD photolyase	GFMG01363798	
	DASH	--	Not found in the TSA
	timeless-d	BBD17785	
	timeless-m	BAJ16356	
	period	BAG48878	
	jetlag	GFMG02019192	
	FBXL3/21	--	Not found in the TSA

Extatosoma tiaratum Metazoa; Arthropoda; Insecta; Polyneoptera; Phasmatodea; Phasmatidae	*cryptochrome-d*	GAWG01038287	
	cryptochrome-m	GDZM01028142	
	6-4 photolyase	GAWG01077025	
	CPD photolyase	GAWG01042139	
	DASH	--	Not found in the TSA
	timeless-d	GAWG01055520	
	timeless-m	GAWG01082569	
	period	GAWG01065288	
	jetlag	GAWG01085039	
	FBXL3/21	--	Not found in the TSA
Blattella germanica Metazoa; Arthropoda; Insecta; Polyneoptera; Blattodea; Blaberoidea; Ectobiidae	*cryptochrome-d*	PSN30513	
	cryptochrome-m	PSN44595	
	6-4 photolyase	--	Not found in the genome, transcriptome, or TSA
	CPD photolyase	PSN38921	
	DASH	--	Not found in the genome, transcriptome, or TSA
	timeless-d	PSN50864	
	timeless-m	GDCR01079487	
	period	PSN42098	
	jetlag	PSN54911	
	FBXL3/21	PSN30125	
Panchlora nivea Metazoa; Arthropoda; Insecta; Polyneoptera; Blattodea; Blaberoidea; Blaberidae	*cryptochrome-d*	GGLV01004172	
	cryptochrome-m	GGLV01000774	
	6-4 photolyase	--	Not found in the TSA
	CPD photolyase	GGLV01037008	
	DASH	--	Not found in the TSA
	timeless-d	GGLV01036753	
	timeless-m	GGLV01058516	
	period	GGLV01007810	
	jetlag	GGLV01043282	
	FBXL3/21	GGLV01006178	
Sundablatta sexpunctata Metazoa; Arthropoda; Insecta; Polyneoptera; Blattodea; Blaberoidea; Ectobiidae	*cryptochrome-d*	GDCJ01022923; GDCJ01060550	2 partial fragments
	cryptochrome-m	GDCJ01050009	
	6-4 photolyase	--	Not found in the TSA
	CPD photolyase	GDCJ01035462	
	DASH	--	Not found in the TSA
	timeless-d	GDCJ01051298; GDCJ01039928	2 partial fragments

	timeless-m	GDCJ01050612	
	period	GDCJ01035574; GDCJ01032306; GDCJ01030317; GDCJ01027825	4 partial fragments
	jetlag	GDCJ01049871	
	FBXL3/21	GDCJ01040350	
Periplaneta americana Metazoa; Arthropoda; Insecta; Polyneoptera; Blattodea; Blattoidea; Blattidae	*cryptochrome-d*	--	Not found in the TSA
	cryptochrome-m	GFCQ01029664	
	6-4 photolyase	--	Not found in the TSA
	CPD photolyase	GBJC01001632; GBJC01038845; GFCQ01030805	3 partial fragments
	DASH	--	Not found in the TSA
	timeless-d	AAM77468; GFCQ01024702	2 partial fragments
	timeless-m	GFCQ01021782	
	period	AAA64677	
	jetlag	GFCQ01021894	
	FBXL3/21	GBJC01001306	
Lamproblatta albipalpus Metazoa; Arthropoda; Insecta; Polyneoptera; Blattodea; Blattoidea; Lamproblattidae	*cryptochrome-d*	--	Not found in the TSA
	cryptochrome-m	GCPS01043497; GCPS01059498	2 partial fragments
	6-4 photolyase	--	Not found in the TSA
	CPD photolyase	GCPS01044676	
	DASH	--	Not found in the TSA
	timeless-d	GCPS01048998; GCPS01038665	2 partial fragments
	timeless-m	GCPS01012790; GCPS01037465	2 partial fragments
	period	GCPS01045300	
	jetlag	GCPS01042505	
	FBXL3/21	GCPS01046280	
Cryptocercus wrighti Metazoa; Arthropoda; Insecta; Polyneoptera; Blattodea; Blattoidea; Cryptocercidae	*cryptochrome-d*	--	
	cryptochrome-m	GAZN02037693	
	6-4 photolyase	--	
	CPD photolyase	--	Not found in the TSA
	DASH	--	
	timeless-d	GAZN02048784	
	timeless-m	GAZN02032331; GAZN02036043; GAZN02043003	3 partial fragments
	period	GAZN02046497	
	jetlag	GAZN02047778	
	FBXL3/21	GAZN02036388	
Porotermes quadricollis	*cryptochrome-d*	--	Not found in the TSA
	cryptochrome-m	GIAG01049439	

Metazoa; Arthropoda; Insecta; Polyneoptera; Blattodea; Blattoidea; Termitoidae; Termopsidae	*6-4 photolyase*	--	Not found in the TSA
	CPD photolyase	--	Not found in the TSA
	DASH	--	Not found in the TSA
	timeless-d	GIAG01134881	partial fragment
	timeless-m	GIAG01078513; GIAG01138183; GIAG01068524	3 partial fragments
	period	GIAG01071532, GIAG01071533	2 fragments
	jetlag	GIAG01123673	partial sequence
	FBXL3/21	GIAG01051392 GIAG01098752 GIAG01132428	3 partial fragments
Zootermopsis nevadensis Metazoa; Arthropoda; Insecta; Polyneoptera; Blattodea; Blattoidea; Termitoidae; Termopsidae	*cryptochrome-d*	--	Absent in the genome
	cryptochrome-m	XP_021920747	
	6-4 photolyase	--	Absent in the genome
	CPD photolyase	--	Absent in the genome
	DASH	--	Absent in the genome
	timeless-d	--	Absent in the genome
	timeless-m	XP_021923761	
	period	XP_021930792	
	jetlag	XP_021920889	
	FBXL3/21	XP_021926215 2	
Cryptotermes secundus Metazoa; Arthropoda; Insecta; Polyneoptera; Blattodea; Blattoidea; Termitoidae; Kalotermitidae	*cryptochrome-d*	--	Absent in the genome
	cryptochrome-m	XP_023706832	
	6-4 photolyase	--	Absent in the genome
	CPD photolyase	--	Absent in the genome
	DASH	--	Absent in the genome
	timeless-d	--	Absent in the genome
	timeless-m	XP_0219237610	
	period	XP_021930792	
	jetlag	XP_023715918	
	FBXL3/21	XP_023723291	
Nasutitermes takasagoensis Metazoa; Arthropoda; Insecta; Polyneoptera;	*cryptochrome-d*	--	Not found in the TSA
	cryptochrome-m	IAEB01005476	
	6-4 photolyase	--	Not found in the TSA

Blattodea; Blattoidea; Termitoidae; Termitidae	*CPD photolyase*	--	Not found in the TSA
	DASH	--	Not found in the TSA
	timeless-d	--	Not found in the TSA
	timeless-m	IAEB01013049	
	period	IAEB01013495	
	jetlag	IAEB01011397	
	FBXL3/21	IAEB01020786	
Megaloprepus caerulatus Metazoa; Arthropoda; Insecta; Palaeoptera; Odonata; Pseudostigmatidae	*cryptochrome-d*	GEXY01066891	
	cryptochrome-m	GEXY01342940	
	6-4 photolyase	GEXY01149320	
	CPD photolyase	GEXY01187320	
	DASH	--	Not found in the TSA
	timeless-d	GEXY01409322	
	timeless-m	GEXY01429671	
	period	GEXY01189581	
	jetlag	--	Not found in the TSA
	FBXL3/21	--	Not found in the TSA
Ephemera danica Metazoa; Arthropoda; Insecta; Palaeoptera; Ephemeroptera; Scapphodonta; Ephemeridae; Ephemera	*cryptochrome-d*	KAF4522540	
	cryptochrome-m	KAF4523712	
	6-4 photolyase	KAF4518708	
	CPD photolyase	KAF4519522	
	DASH	--	Not found in the TSA
	timeless-d	KAF4523325 KAF4523326 KAF4529908	3 partial fragments
	timeless-m	KAF4529908 KAF4531667	2 partial fragments
	period	KAF4520745 KAF4527595 KAF4528952 KAF4528976	4 partial fragments
	jetlag	KAF4516930	
	FBXL3/21	KAF4517907	
Sminthurus viridis Metazoa; Arthropoda; Collembola; Symphypleona; Sminthuridae	*cryptochrome-d*	GATZ02010310	
	cryptochrome-m	GATZ02009173	
	6-4 photolyase	--	Not found in the genome, transcriptome, or TSA
	CPD photolyase	GATZ02022208	
	DASH	GATZ02022546	
	timeless-d	GATZ02010498	
	timeless-m	GATZ02017020	

	period	GATZ02006475	
	jetlag	GATZ02008436	
	FBXL3/21	--	Not found in the TSA
Daphnia pulex Metazoa; Arthropoda; Crustacea; Diplostraca; Daphniidae	*cryptochrome-d*	EFX85418	
	cryptochrome-m	EFX82092	
	6-4 photolyase	EFX85418	
	CPD photolyase	EFX71237	
	DASH	EFX86680	
	timeless-d	EFX80642	
	timeless-m	EFX80319	
	period	EFX76293	
	jetlag	EFX83363	
	FBXL3/21	--	Not found in TSA, transcriptome, or genome
Limulus polyphemus Metazoa; Arthropoda; Chelicerata; Merostomata; Xiphosura; Limulidae	*cryptochrome-d*	XP_022257009	
	cryptochrome-m	ANO53972	
	6-4 photolyase	XP_022247971	
	CPD photolyase	XP_013787452	
	DASH	--	Not found in the genome, transcriptome, or TSA
	timeless-d	XP_022254152	
	timeless-m	XP_022243537	
	period	ANO53971	
	jetlag	XP_013780499	
	FBXL3/21	XP_022254049	
Araneus ventricosus Metazoa; Arthropoda; Chelicerata; Arachnida; Araneae; Araneidae	*cryptochrome-d*	GBN19159	
	cryptochrome-m	GBM49213	
	6-4 photolyase	GBM67888	
	CPD photolyase	GBN22197	
	DASH	--	Not found in the TSA
	timeless-d	GBM21781	
	timeless-m	GBN56120	
	period	GBM95439	
	jetlag	GBN49390	
	FBXL3/21	--	Not found in the TSA
Tetranychus urticae Metazoa; Arthropoda; Chelicerata; Arachnida; Acari; Trombidiformes; Tetranychidae	*cryptochrome-d*	XP_025017376	
	cryptochrome-m	XP_015785840	
	6-4 photolyase	--	Not found in the TSA, transcriptome, or genome
	CPD photolyase	XP_015787507	

	DASH	--	Not found in the TSA, transcriptome, or genome
	timeless-d	XP_025017966	
	timeless-m	XP_015789018	
	period	XP_015786774	
	jetlag	XP_015786213	
	FBXL3/21	--	Not found in the TSA, transcriptome, or genome
Platynereis dumerilii Metazoa; Annelida; Polychaeta; Phyllodocida; Nereididae	*cryptochrome-d*	AEJ87227	
	cryptochrome-m	AGX93012	
	6-4 photolyase	AGX93015	
	CPD photolyase	AIE57497	
	DASH	AIE57496	
	timeless-d	HALR01337992	
	timeless-m	HAMO01053063	
	period	HALR01343176	
	jetlag	HAMO01014748	
	FBXL3/21	--	Not found in the TSA, transcriptome, or genome
Crassostrea gigas Metazoa; Mollusca; Bivalvia; Ostreida; Ostreidae	*cryptochrome-d*	ANJ02841	
	cryptochrome-m	AQM57602	
	6-4 photolyase	XP_011414697	
	CPD photolyase	XP_011422754	
	DASH	XP_011441094	
	timeless-d	AQM57605	
	timeless-m	XP_011441580	
	period	XP_011434453	
	jetlag	XP_011444755	
	FBXL3/21	--	Not found in the TSA
Aplysia californica Metazoa; Mollusca; Gastropoda; Aplysiida; Aplysiidae	*cryptochrome-d*	XP_005089742	
	cryptochrome-m	XP_012941094	
	6-4 photolyase	XP_012944453	
	CPD photolyase	XP_012935158	
	DASH	XP_005098341	
	timeless-d	XP_012943985	
	timeless-m	XP_012938690	
	period	XP_012944985	
	jetlag	XP_005101190	
	FBXL3/21	--	Not found in the TSA
Octopus vulgaris	*cryptochrome-d*	XP_029634730	
	cryptochrome-m	XP_029646224	

Metazoa; Mollusca; Cephalopoda; Octopoda; Octopodidae	*6-4 photolyase*	--	not in TSA of any Cephalopoda (taxid:6605)
	CPD photolyase	XP_029648244	
	DASH	--	not in TSA of any Cephalopoda (taxid:6605)
	timeless-d	XP_029642111	
	timeless-m	XP_029654177	
	period	XP_029633045	
	jetlag	JR436235	
	FBXL3/21	--	Not found in the TSA
Sepia esculenta Metazoa; Mollusca; Cephalopoda; Sepiida; Sepiidae	*cryptochrome-d*	GGQU01009236	
	cryptochrome-m	GGQU01028147	
	6-4 photolyase	--	not in TSA of any Cephalopoda (taxid:6605)
	CPD photolyase	GGQU01005854	
	DASH	--	not in TSA of any Cephalopoda (taxid:6605)
	timeless-d	GGQU01018501	
	timeless-m	GGQU01119589	
	period	GGQU01013326	
	jetlag	GGQU01008949	
	FBXL3/21	--	Not found in the TSA
Strongylocentrotus purpuratus Metazoa; Echinodermata; Echinoidea; Camarodonta; Strongylocentrotidae	*cryptochrome-d*	XP_030843606	
	cryptochrome-m	XP_785873	
	6-4 photolyase	XP_030853363	
	CPD photolyase	XP_030838243	
	DASH	XP_030855350	
	timeless-d	XP_011666280	
	timeless-m	XP_784350	
	period	--	Absent in the TSA, proteins, and genome
	jetlag-related	XP_030835612	
	FBXL3/21	XP_011668197	
Acanthaster planci Metazoa; Echinodermata; Asteroidea; Valvatida; Acanthasteridae	*cryptochrome-d*	XP_022112080	
	cryptochrome-m	XP_022093922	
	6-4 photolyase	XP_022085333	
	CPD photolyase	XP_022095977	
	DASH	XP_022106989	
	timeless-d	XP_022095151	
	timeless-m	XP_022107896	
	period	--	Absent in the TSA, proteins, and genome

	jetlag-related	XP_022086279	
	FBXL3/21	XP_022086809	
Ptychodera flava Metazoa; Hemichordata; Enteropneusta; Ptychoderidae	*cryptochrome-d*	GDGM01320022	
	cryptochrome-m	GDGM01087240	
	6-4 photolyase	GDGM01051165	
	CPD photolyase	GDGM01188624	
	DASH	GDGM01423525	
	timeless-d	GDGM01251144	
	timeless-m	GDGM01011345GDGM01415766	2 partial fragments
	period	--	Absent in the TSA, proteins, and genome
	jetlag-related	GDGM01503414	
	FBXL3/21	GDGM01093178	
Branchiostoma floridae **Metazoa; Chordata;** Leptocardii; Branchiostomidae	*cryptochrome-d*	--	Absent in the genome
	cryptochrome-m	XP_035662695	
	6-4 photolyase	XP_035662689 XP_035688923	2 paralogs
	CPD photolyase	XP_035694008	
	DASH	--	
	timeless-d	--	Absent in the genome
	timeless-m	XP_035657364	
	period	XP_035696876	
	jetlag	XP_035692716	
	FBXL3/21	XP_035682891	
Petromyzon	*cryptochrome-d*	--	Absent in the genome
	cryptochrome-m	XP_032805096	
	6-4 photolyase	--	
	CPD photolyase	XP_032801148	
	DASH	--	
	timeless-d	--	Absent in the genome
	timeless-m	XP_032813202	
	period	XP_032817908	
	jetlag-related	XP_032805591	
	FBXL3/21	XP_032832820	
Danio rerio Metazoa; Chordata; Vertebrata; Actinopteri; Teleostei; Cypriniformes; Danionidae	*cryptochrome-d*	--	Absent in the genome, transcriptome, and TSA
	cryptochrome-m	BAA96850; BAA96848; BAA96847; BAA96846;	4 paralogs
	6-4 photolyase	AAI64413; XP_005155462	2 paralogs
	CPD photolyase	XP_005168471	
	DASH	NP_991249	

	timeless-d	--	Absent in the genome, transcriptome and TSA
	timeless-m	NP_001265529	
	period1	XP_005172684	
	period2	AAI63549	
	period3	AAI62472	
	jetlag-related	NP_998107	
	FBXL3/21	NP_001005773; XP_693270	2 paralogs
Xenopus laevis Metazoa; Chordata; Vertebrata; Tetrapoda; Amphibia; Anura; Pipidae	*cryptochrome-d*	--	Absent in the genome, transcriptome, and TSA
	cryptochrome-m	AAK94667; AAK94665	2 paralogs
	6-4 photolyase	NP_001088990; NP_001081421	2 paralogs
	CPD photolyase	NP_001089127	
	DASH	NP_001084438	
	timeless-d	--	Absent in the genome, transcriptome, and TSA
	timeless-m	XP_018105525	
	period1	XP_018106090	
	period2	NP_001081098	
	period3	XP_018081638; XP_018083480	
	jetlag-related	NP_001079747	
	FBXL3/21	XP_018105395; XP_018107511	
Anolis carolinensis Metazoa; Chordata; Vertebrata; Tetrapoda; Sauria; Lepidosauria; Squamata; Dactyloidae	*cryptochrome-d*	--	Absent in the genome
	cryptochrome-m	XP_003220970; XP_003214689	2 paralogs
	6-4 photolyase	XP_008108122; XP_003225762	2 paralogs
	CPD photolyase	XP_003227011	
	DASH	XP_008110409	
	timeless-d	--	Absent in the genome
	timeless-m	XP_016846705	
	period1	XP_008117781	
	period2	XP_008104509	
	period3	--	
	jetlag-related	XP_003223176	
	FBXL3/21	XP_008113732; XP_003218703	
Taeniopygia guttata Metazoa; Chordata; Vertebrata; Tetrapoda; Sauria; Archelosauria;	*cryptochrome-d*	--	Absent in the genome
	cryptochrome-m	XP_030130159; XP_030118992	2 paralogs
	6-4 photolyase	XP_012426408	
	CPD photolyase	XP_030136454	
	DASH	XP_030120072	

Dinosauria; Aves; Passeriformes; Estrildidae	*timeless-d*	--	
	timeless-m	XP_030115154	
	period1	--	
	period2	XP_030136609	
	period3	XP_012425833	
	jetlag-related	XP_030131830	
	FBXL3/21	XP_030139641; XP_002199560	
Vombatus ursinus Metazoa; Chordata; Vertebrata; Tetrapoda; Mammalia; Diprotodontia; Vombatidae	*cryptochrome-d*	--	Absent in the genome
	cryptochrome-m	XP_027693622; XP_027728959	2 paralogs
	6-4 photolyase	--	Absent in the genome
	CPD photolyase	XP_027701119	
	DASH	--	Absent in the genome
	timeless-d	--	Absent in the genome
	timeless-m	XP_027710880	
	period1	XP_027725776	
	period2	XP_027731061	
	period3	XP_027699731	
	jetlag-related	XP_027707763	
	FBXL3/21	XP_027700340	
Mus musculus Metazoa; Chordata; Vertebrata; Tetrapoda; Mammalia; Rodentia; Murinae	*cryptochrome-d*	--	Absent in the genome
	cryptochrome-m	4K0R_A; NP_034093	2 paralogs
	6-4 photolyase	--	Absent in the genome
	CPD photolyase	--	Absent in the genome
	DASH	--	Absent in the genome
	timeless-d	--	Absent in the genome
	timeless-m	NP_001157553	
	period1	NP_001152839	
	period2	NP_035196	
	period3	XP_011248505	
	jetlag-related	NP_001365702	
	FBXL3/21	NP_056637; NP_848789	
Homo sapiens Metazoa; Chordata; Vertebrata; Tetrapoda; Mammalia; Primates; Hominidae	*cryptochrome-d*	--	Absent in the genome
	cryptochrome-m	BAG64048; NP_004066	2 paralogs
	6-4 photolyase	--	Absent in the genome
	CPD photolyase	--	Absent in the genome
	DASH	--	Absent in the genome

	timeless-d	--	Absent in the genome
	timeless-m	NP_003911	
	period1	NP_002607	
	period2	NP_073728	
	period3	NP_001276790	
	jetlag-related	XP_005270206	
	FBXL3/21	FXL21_HUMAN; NP_036290	

Supplementary Table 2. Summary on genes absence in entire metazoan lineages

Metazoan lineage	Absent gene	note
Higher Diptera	*cryptochrome-m*	Absent in all Cyclorrhapha (taxid:480117)
Crown Coleoptera	*jetlag*	absent in TSAs and genomes of Scarabaeoidea (taxid:75546), Tenebrionoidea (taxid:71527), Chrysomeloidea (71528), Curculionoidea (71529)
	cryptochrome-d	absent in TSAs and genomes of Scarabaeoidea (taxid:75546), Tenebrionoidea (taxid:71527), Chrysomeloidea (71528), Curculionoidea (71529)
	6-4 photolyase	absent in TSAs and genomes of Scarabaeoidea (taxid:75546), Tenebrionoidea (taxid:71527), Chrysomeloidea (71528), Curculionoidea (71529)
	CPD photolyase	absent in TSAs and genomes of Scarabaeoidea (taxid:75546), Tenebrionoidea (taxid:71527), Chrysomeloidea (71528), Curculionoidea (71529)
Hymenoptera	*timeless-d*	Absent in all Hymenoptera (taxid:7399)
	jetlag	Absent in all Hymenoptera (taxid:7399)
	cryptochrome-d	Absent in all Hymenoptera (taxid:7399)
	6-4 photolyase	Absent in all Hymenoptera (taxid:7399)
Aphids	*jetlag*	Absent in all Aphids (taxid:33380)
Heteroptea	*6-4 photolyase*	Absent in all Heteroptera (taxid:33345)
	cryptochrome-d	absent in TSAs, proteins, and genomes Cimicomorpha (taxid:33354) and Pentatomomorpha (taxid:33357)
Hemipteroid assembly (Heteroptera, Auchenorrhyncha, Sternorrhyncha,	*FBXL3/21*	Absent in all Heteroptera (taxid:33345) Absent in all Auchenorrhyncha (taxid:1955247) Absent in all Sternorrhyncha (taxid:33373)
Blattodea (including termites)	*6-4 photolyase*	absent in TSAs, proteins, and genomes of all available Blattodea (taxid:85823) & Termites (taxid:7499)
	cryptochrome-d	absent in TSAs, proteins, and genomes of all available Termites (taxid:7499), Cryptocercidae (taxid:36982), Lamproblattidae (taxid:1080998), Blattidae (taxid:6974)
	CPD photolyase	absent in TSAs, proteins, and genomes of all available Termites (taxid:7499) and Cryptocercidae (taxid:36982)
	timeless-d	With the exception of *Porotermes quadricollis*, absent in TSAs, proteins, and genomes of all available Termites (taxid:7499)
Insecta	*DASH*	Absent in TSAs, proteins, and genomes of all available insects, except for *Bemisia* (which seems to be plant contamination)
Chelicerata	*DASH*	Absent in TSAs, proteins, and genomes of all available Chelicerata (taxid:6843)

Mollusca	*6-4 photolyase*	Absent in TSAs, proteins, and genomes of all available Cephalopoda (taxid:6605)
	DASH	Absent in TSAs, proteins, and genomes of all available Cephalopoda (taxid:6605)
Echinodermata	*period*	Absent in TSAs, proteins, and genomes of all available Echinodermata (taxid:7586)
Hemichordata	*period*	Absent in TSAs, proteins, and genomes of all available Hemichordata (taxid:10219)
Vertebrata	*timeless-d*	Absent in TSAs, proteins, and genomes of all available Vertebrata (taxid:7742)
	cryptochrome-d	Absent in TSAs, proteins, and genomes of all available Vertebrata (taxid:7742)
	6-4 photolyase	Absent in TSAs, proteins, and genomes of all available Mammalia (taxid:40674)
	DASH	Absent in TSAs, proteins, and genomes of all available Mammalia (taxid:40674)
	CPD photolyase	Absent in TSAs, proteins, and genomes of all available Placentalia (taxid:9347)

Supplementary Table 3. Circadian clock gene homologs and closely related genes identified in the Linden bug, *Pyrrhocoris apterus*

gene	**acc#**	**note**
period	MW662133	gene model
timeless-d	MW662134	gene model
cryptochrome-m	MW662132	gene model
Clock	MW662127	cDNA sequence
cycle	MW662128	cDNA sequence
clockwork orange	MW662123	cDNA sequence
Pdp1	MW662129	cDNA sequence
vrille	MW662124	cDNA sequence
double time	MW662125	cDNA sequence
shaggy	MZ399198	cDNA sequence
nemo	MZ399197	cDNA sequence
slimb	MW662126	cDNA sequence
CPD photolyase	MW662130	cDNA sequence
timeless-m	MW662131	cDNA sequence

Supplementary Table 4. Primers used to clone cDNA templates used for dsRNA synthesis

gene		Forward (5´→3´)	Reverse (5´→3´)	product
period	fr #1	ACACAGTTTTACGGGGACCAC	GTTATTGGAGCCGGGGATTGT	605 bp
	fr #2	CAAAGGATATGTGGGCTGGTAG	GTGCTGGCAAATGACAAACTC	623 bp
tim-d	fr #1	ATGGCAGAACAGATGGAATGGT	TCGGATATGGGGTCTGATGTTAC	839 bp
	fr #2	CACCGAACGGAGACGATGTA	TTTTAAGCGAAGTAGGTATTGTGC	885 bp
tim-m	fr #1	GGGAAATTTGGCCAGAAAACGA	TTCTGTTCTTCGGTCCAGGATG	805 bp
	fr #2	AATTATTTGACTTGATATTAAGGCTTATAGT	GCCTGGAGCCAAGGTATTGT	600 bp
cry-m	fr #1	GCTGCAACAAAGAACCCAAAT	TAGAGGCTGGAGGAGCAAATA	697 bp
	fr #2	TGGTTCGCAAATGCTTCTAATG	GACTTGTCCGTGTAGAGAAAGAG	752 bp
Clock	fr #1	GAAGGGGCAACAGTGGATA	GATGCTTGAAGGGAATGTCTC	300 bp
	fr #2	ATTTTAGGCCCTTCTGCTGACT	CGAGACTATGCCTTGATGTGAAT	307 bp
cycle	fr #1	ATGGCTATGGACGTTGTACAGGT	GGAGGATGATAGGCCCTGATTG	956 bp
	fr #2	ATCAACGTACGCCCACTAC	CATGTCTCGGCCCGATATT	453 bp
cwo	fr #1	CCAACTCGCAACCCATCTAA	AGCCCAGGATCCAAACATATC	399 bp
	fr #2	CACGGCCATCAAATACGAAAG	GTAACCTTCCGAGTCAACAAGA	403 bp
Pdp1	fr #1	AAAAAGATGAAGCAGAGC	CAGCAGGTGAAGGTGGTG	318 bp
	fr #2	AACATTATCATTTGCCTCATC	GACAGCCTTTCCTTTAGTG	315 bp
vrille	fr #1	CATCTCCTCCAATAGTCCCTTTAC	CTGCTACCTTCGCCATCCCAAG	385 bp
	fr #2	TGACCTGGGATCAATACCTAGA	TTGGAACTGAATTGGCTGGA	473 bp
dbt	fr #1	CTCAGAGTCGGAAATAAATA	TTCCTAAATGAGTGTTGAGA	556 bp
	fr #2	TAGGAATTGAACAAAGCAGAAGAG	CTAGGGGGTAAGGCGAGTG	502 bp
sgg	fr #1	CTGAGGGTAACAAGCAAACT	CGATGGCAGATACCGAGAG	502 bp
	fr #2	AGCCGCAAAATCTTCTCCTC	GATGGGTCTCTTAATTCGTCAAAA	493 bp
nmo	fr #1	GTAGGGGAGTGAGAACAGCCAGTATG	GCGAGCCAGCCCGAAGTCAC	542 bp
	fr #2	CGCCGTGGACGTCTGGAGTGTAG	TTGAACGCAGCCGATTGTGGATTTAT	561 bp
slimb	fr #1	CACAGCTTAGCGGAATGACA	TCCTGGCTTTGGTTTGAATA	458 bp
	fr #2	ATTGGAGGCTAGGAAGATTTA	TCGCCGGAAGCAGATAC	481 bp

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