Light manipulation of mosquito behavior: Acute and sustained photic suppression of biting in the *Anopheles gambiae* malaria mosquito

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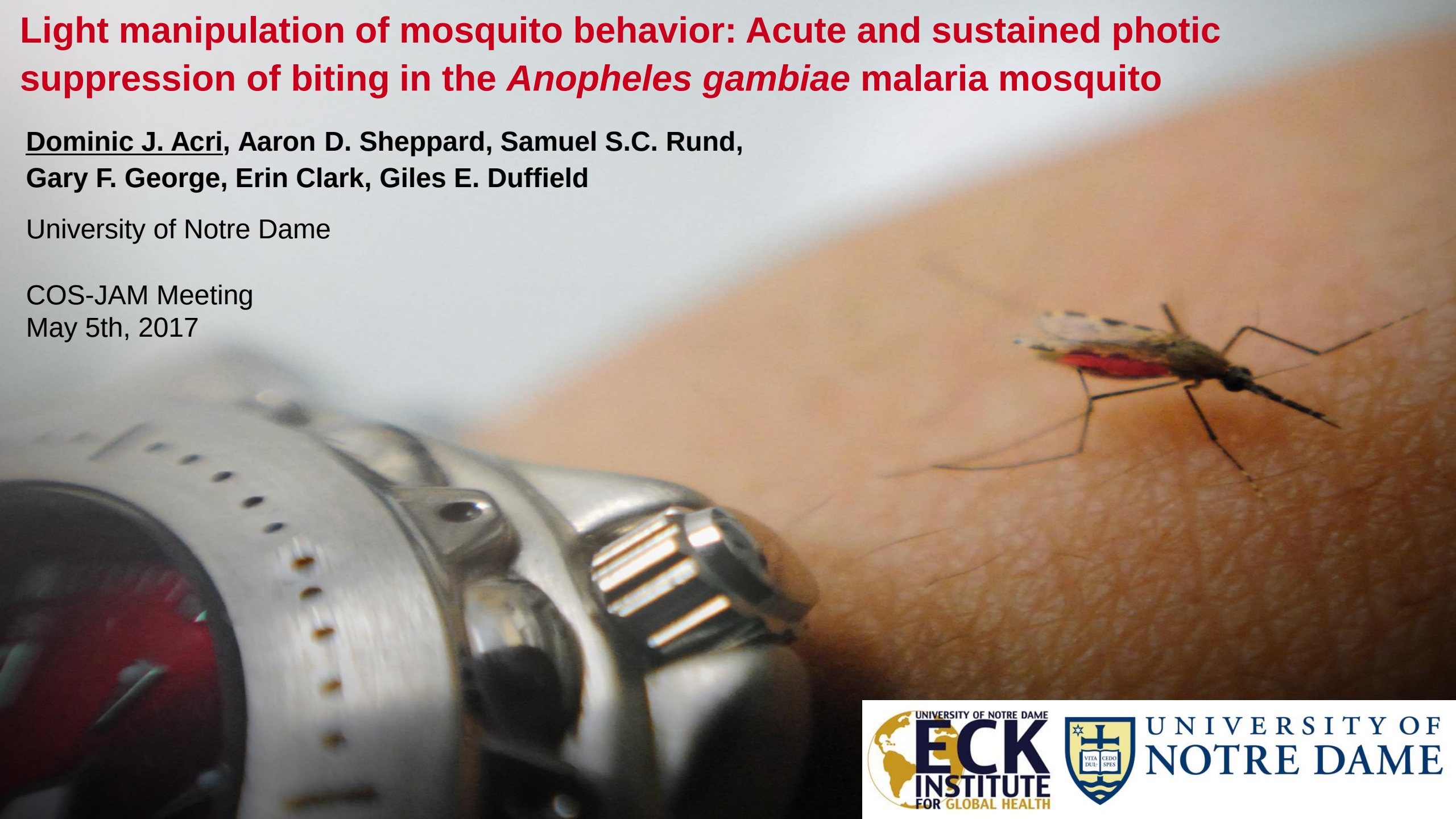
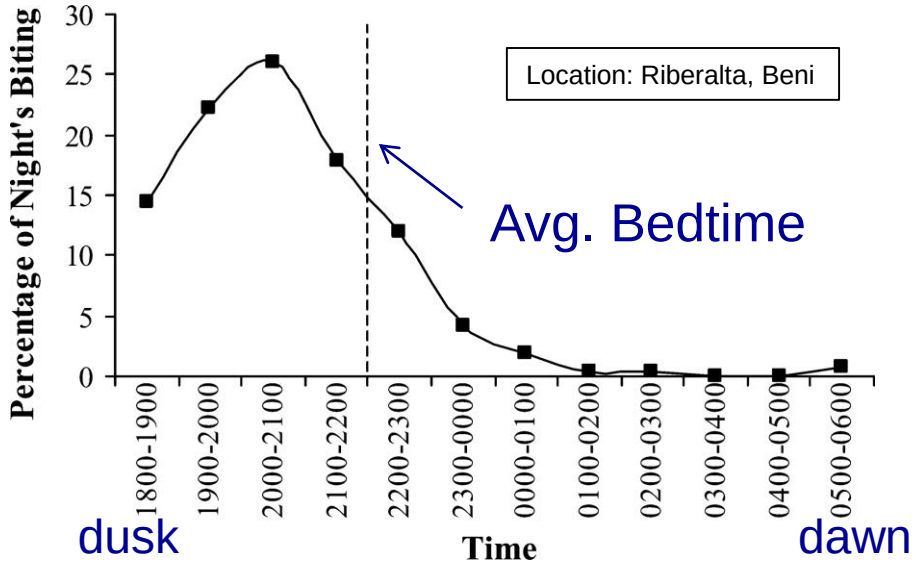


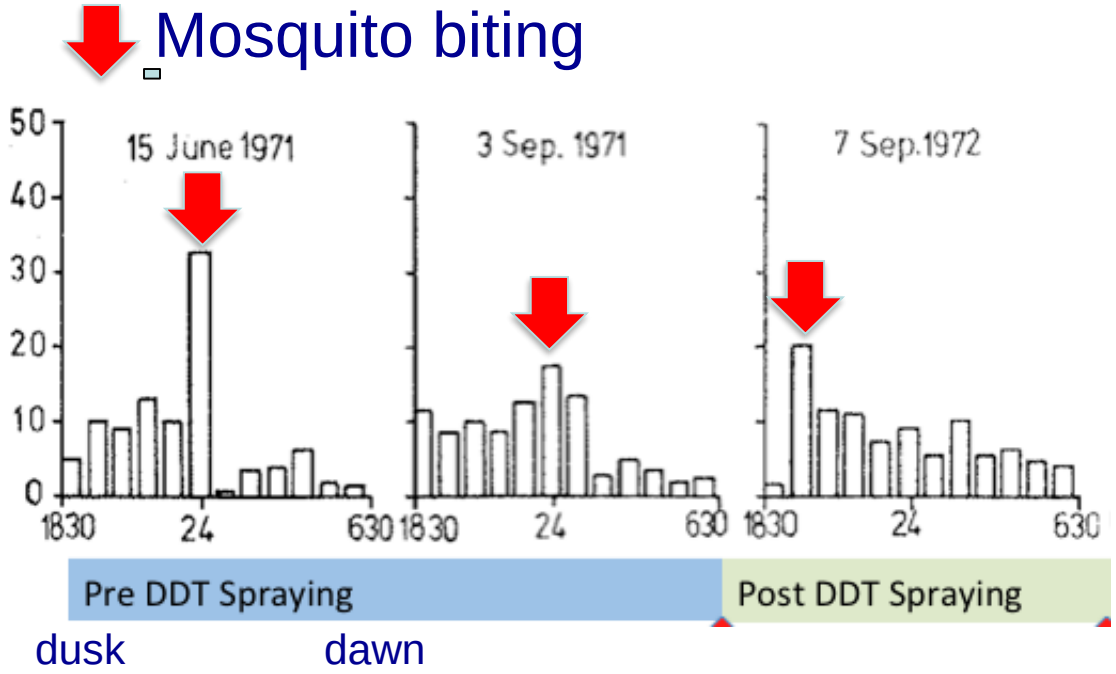
Diel timing of biting affects efficacy of insecticidal treated bed nets

Percentage of night's biting by *An. darlingi* in the Bolivian Amazon



Harris et al (2006) *Trans R Soc Trop Med Hyg* 100: 45-47

Hourly biting activity of *An. farauti* in the Solomon Islands before and after DDT residual spraying of houses



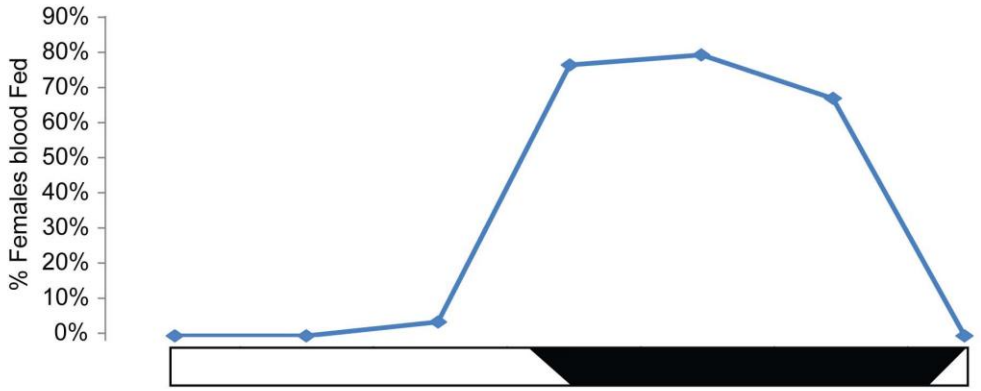
Taylor (1975) *Proc Roy Ent Soc Lond*127: 277-292

An. gambiae show daily rhythms in biting / blood feeding behavior

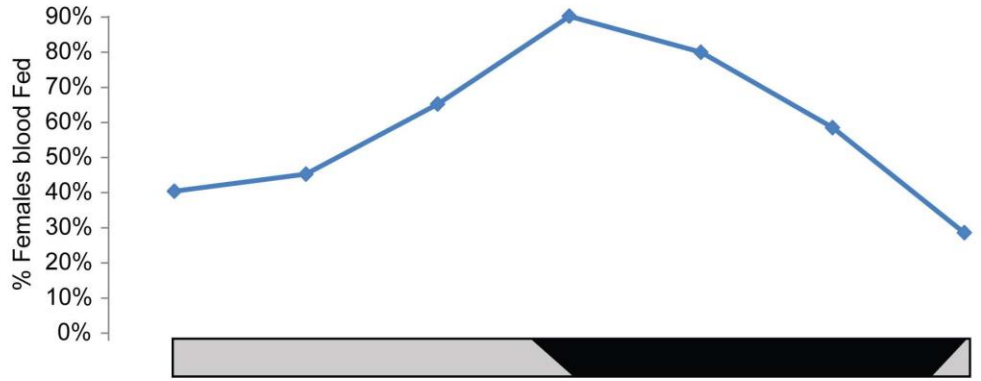
Biting/blood feeding propensity human arm assay

An. gambiae s.s. Pimperena strain (S-form)

LD cycle



constant darkness



Rund *et al.* 2011, *PNAS* 108:E421-430
Rund *et al.* 2013, *Scientific Reports* 3: 2494

Photic cues to suppress biting behavior?

- Does light suppress biting behavior in an efficacious and reproducible manner?
- Can we use photic stimuli as a complementary control method?

1. Effect of single light pulse presented during the **early night**.
2. Effect of light during the **late daytime**.
3. Effect of single light pulse examined at **different times** of the night.
4. **Multiple pulses** of light to inhibit biting throughout the night.

Photic manipulation of *An. gambiae* mosquitoes

- 25-35 female Pimperena strain (S-form) mosquitoes per bucket/mesh lid.
- Buckets in light-tight boxes.

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- Biting propensity assessed after 6 min exposure to inner forearm.
- Proportion of blood-fed mosquitoes (full or partial) determined.

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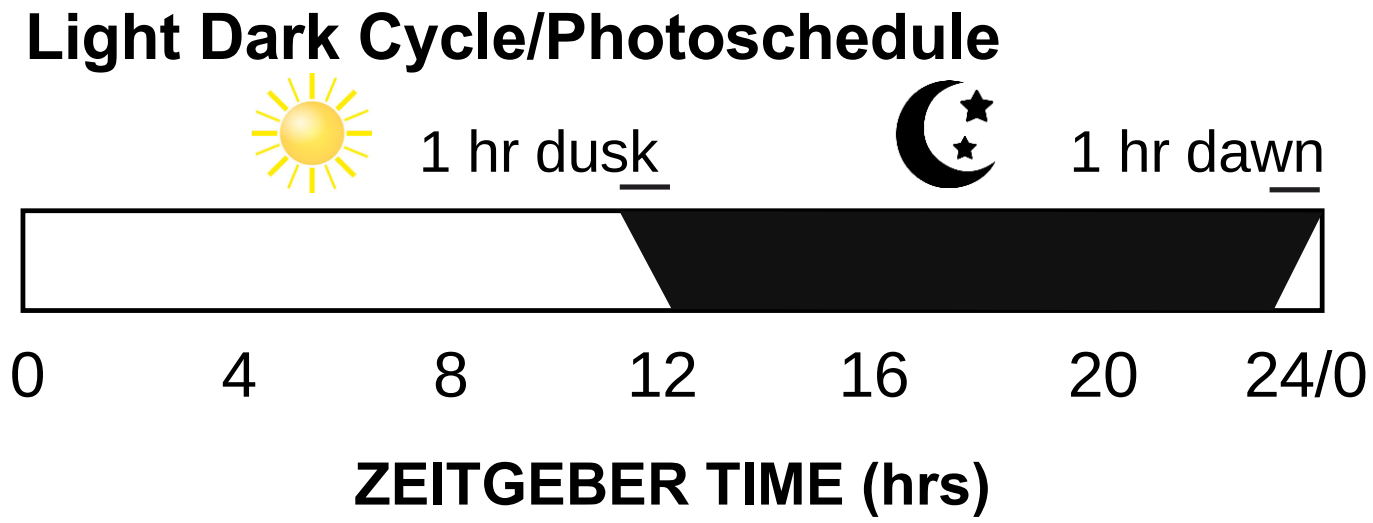
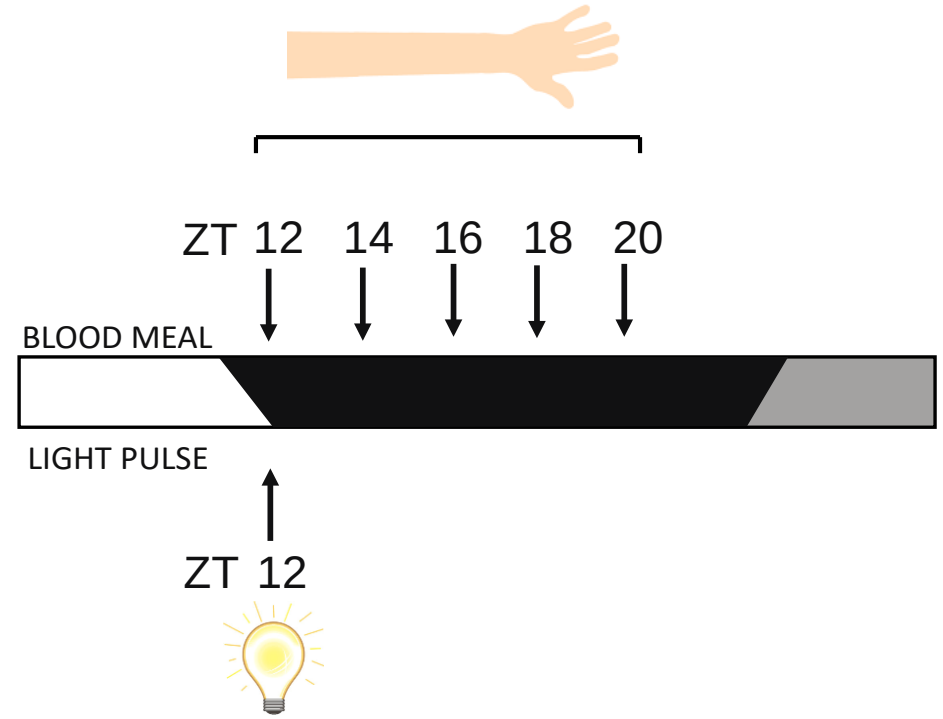
- Proportion of blood-fed mosquitoes (full or partial) determined.
- 3-5 replications

Zeitgeber Time (standardized time)

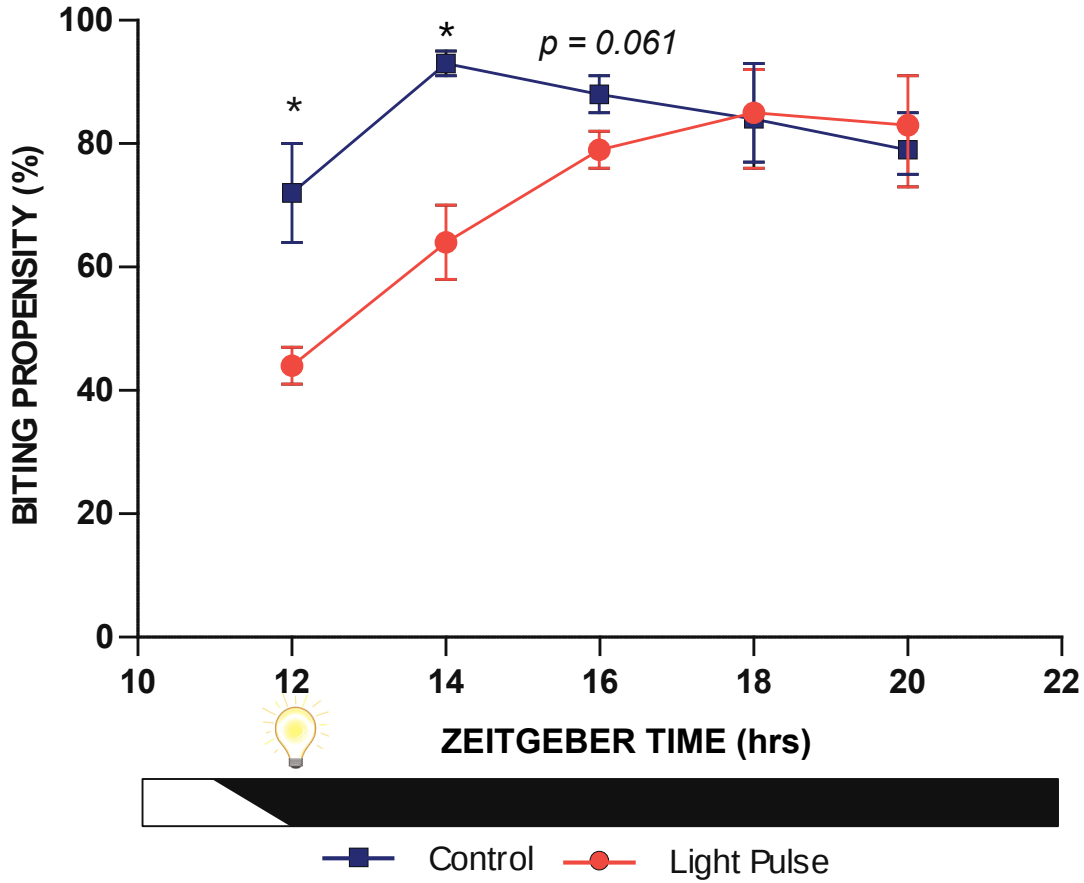


Biting behavior can be suppressed by a pulse of light delivered during the early night

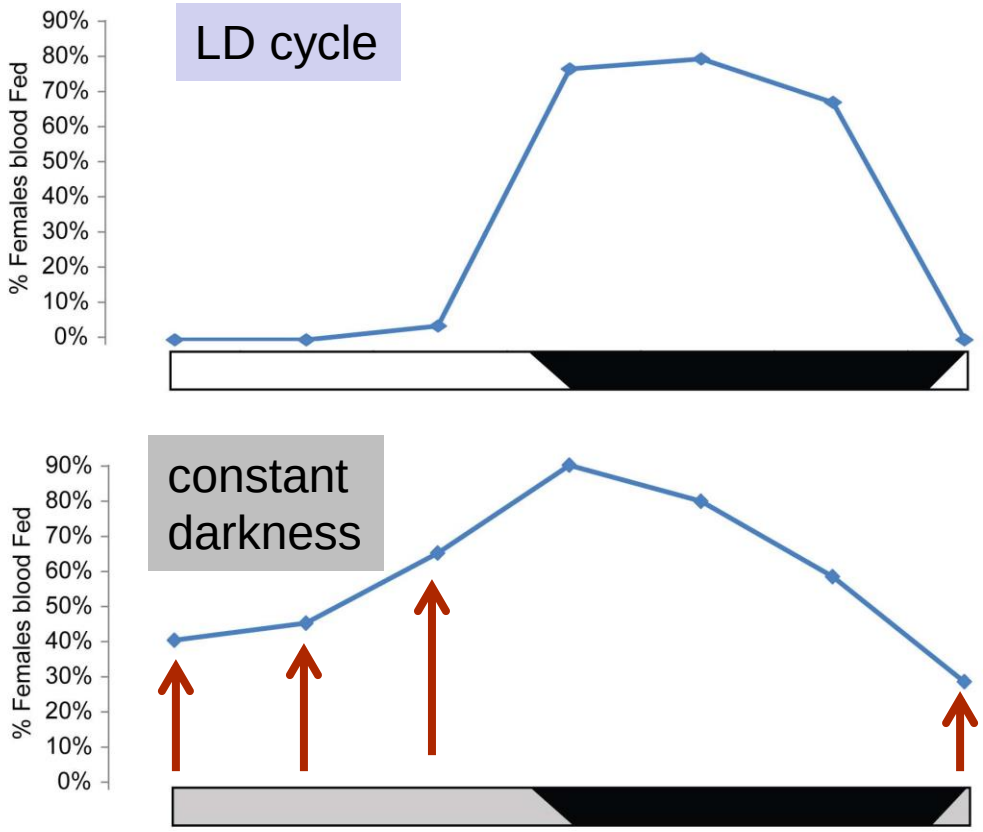
(biting assay in the dark)

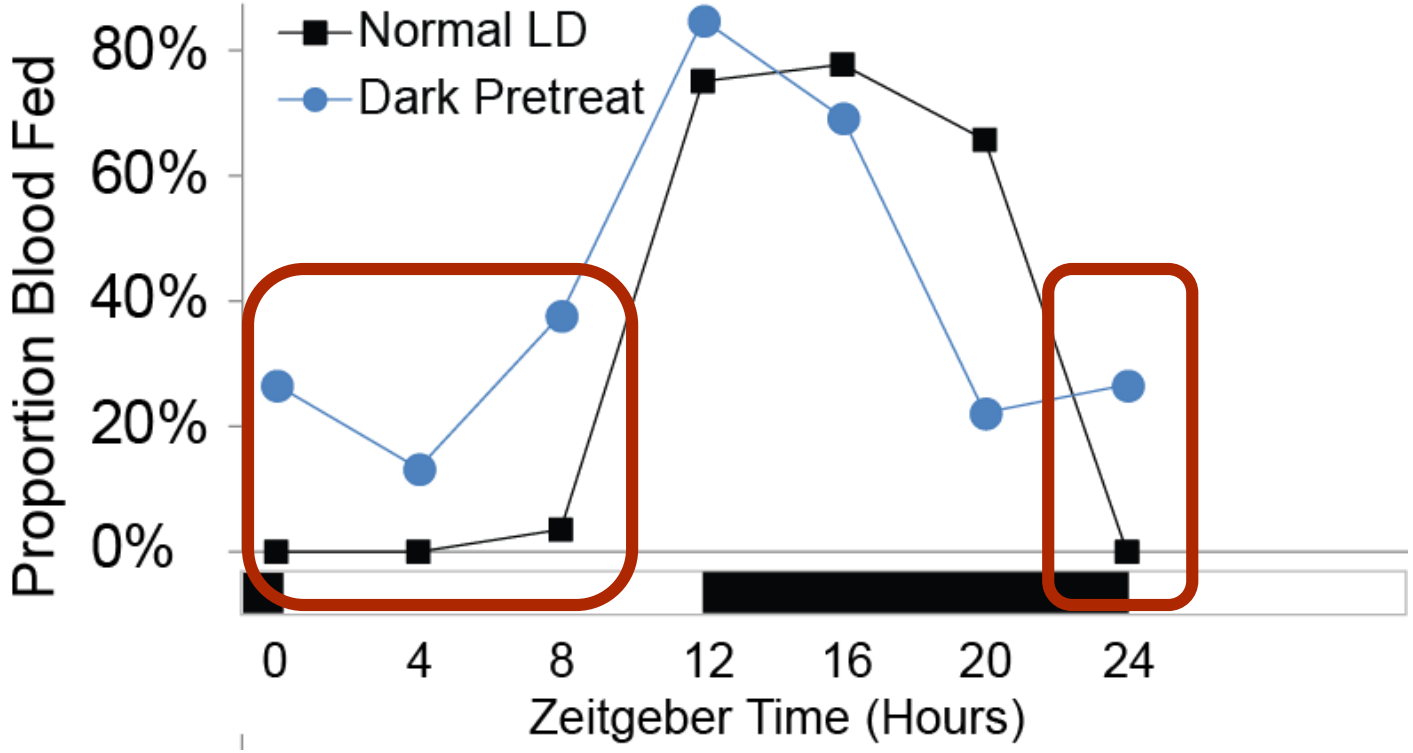


(single 10 min pulse 300 lux)



A 15 min pretreatment of darkness raises biting propensity during the daytime

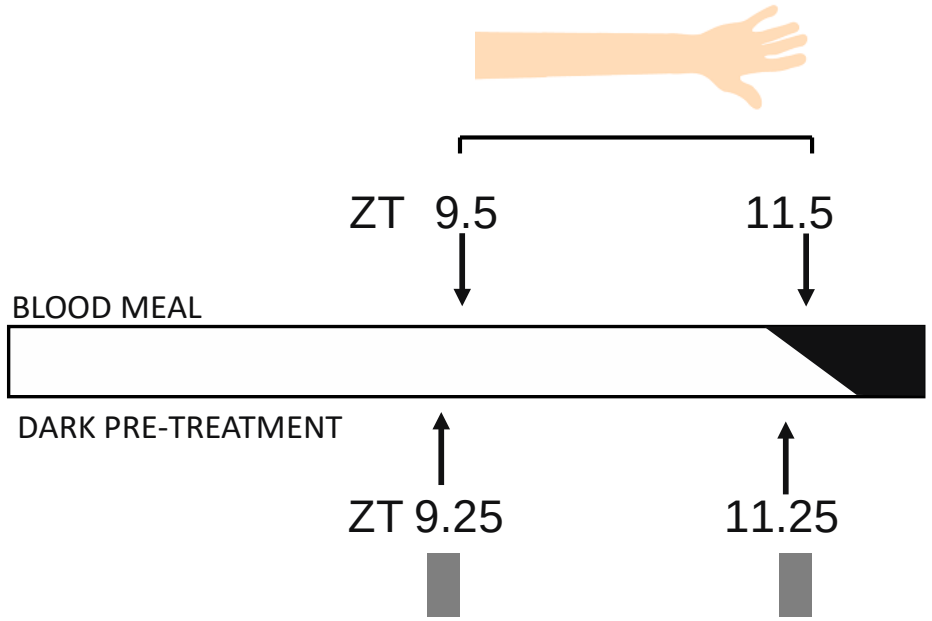


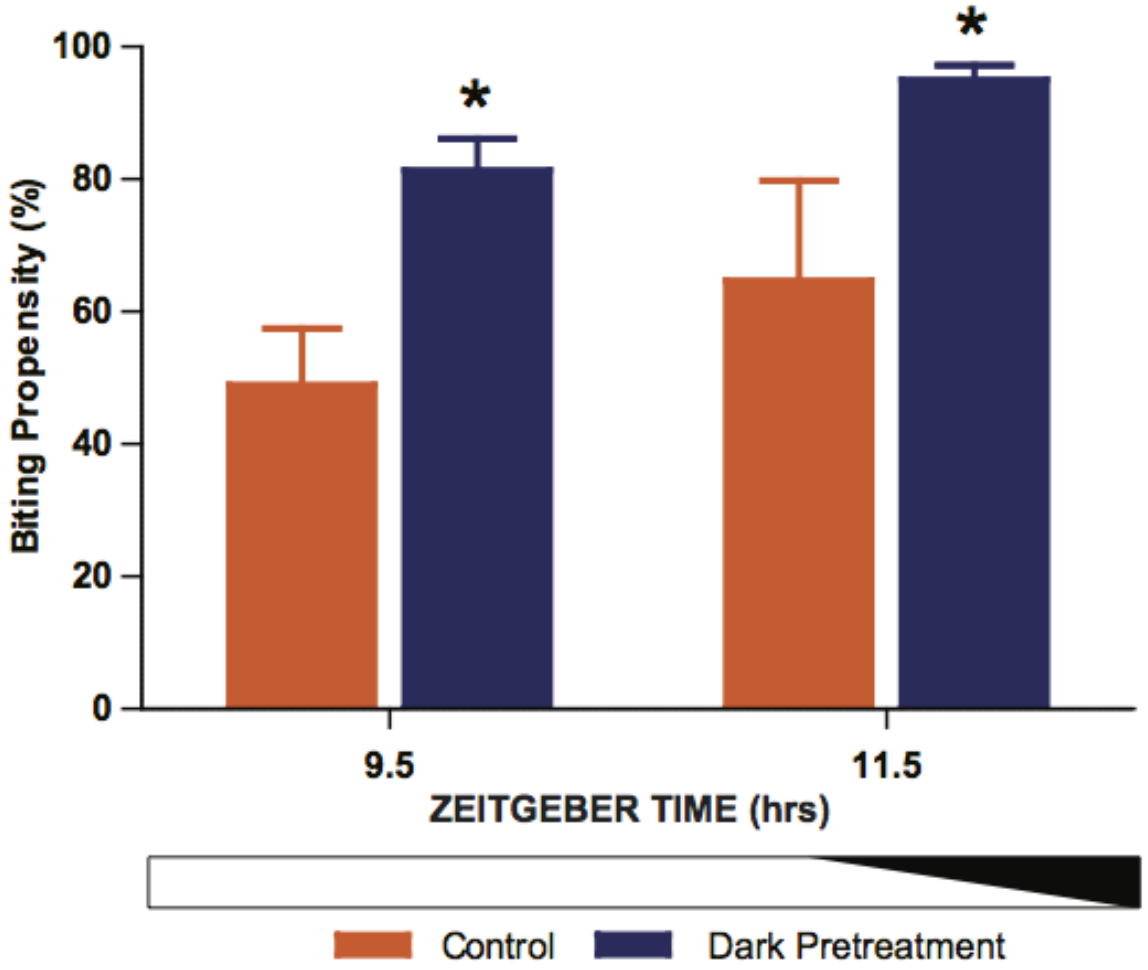


Rund *et al.* 2013, *Scientific Reports* 3: 2494

Increased biting propensity from a dark pre-treatment during late daytime

(biting assay in the dark)

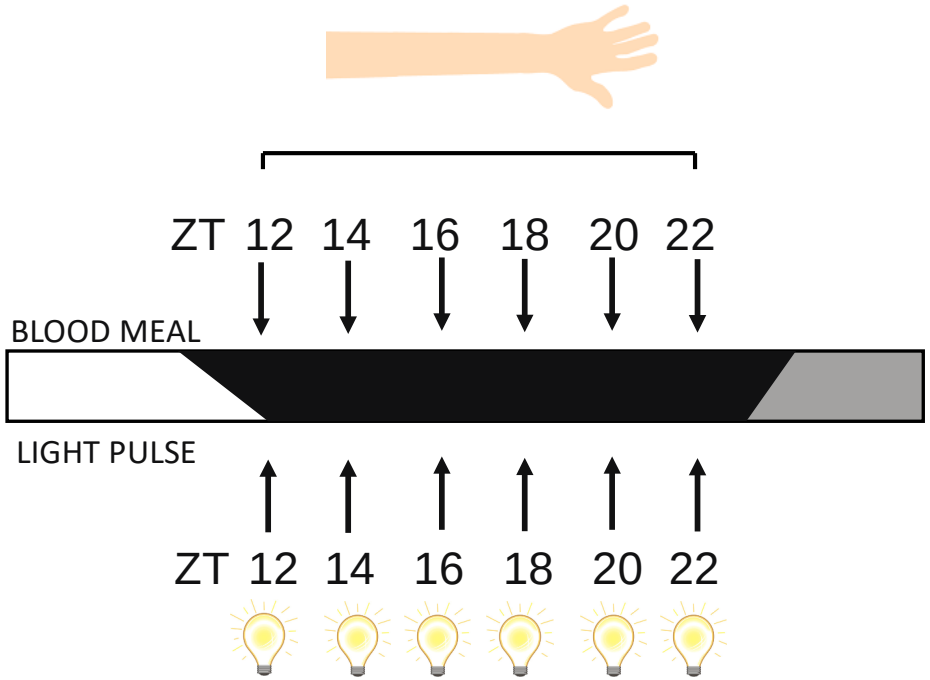




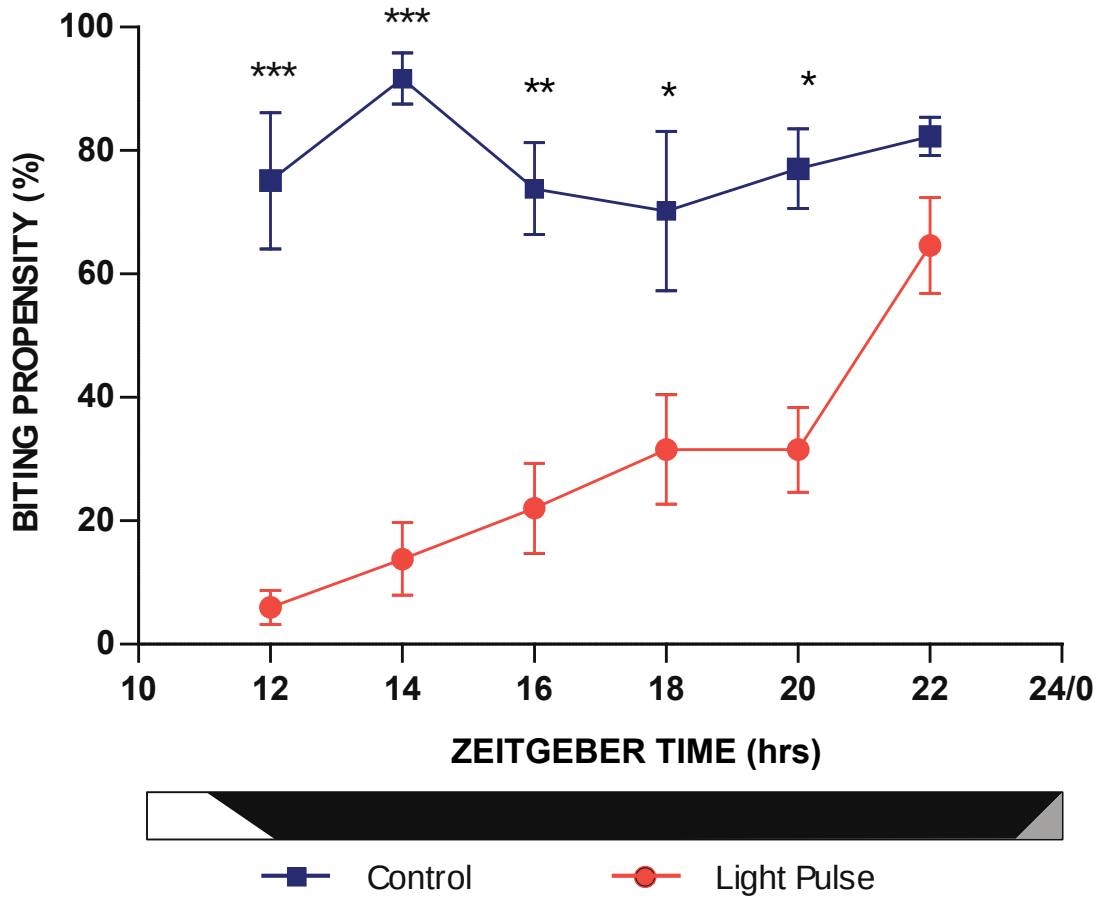
(single 15 min treatment of complete darkness immediately prior to feeding assay in the dark)

Light can *immediately* suppress biting activity when presented at *almost all* phases of the night

(biting assay in light during the pulse)



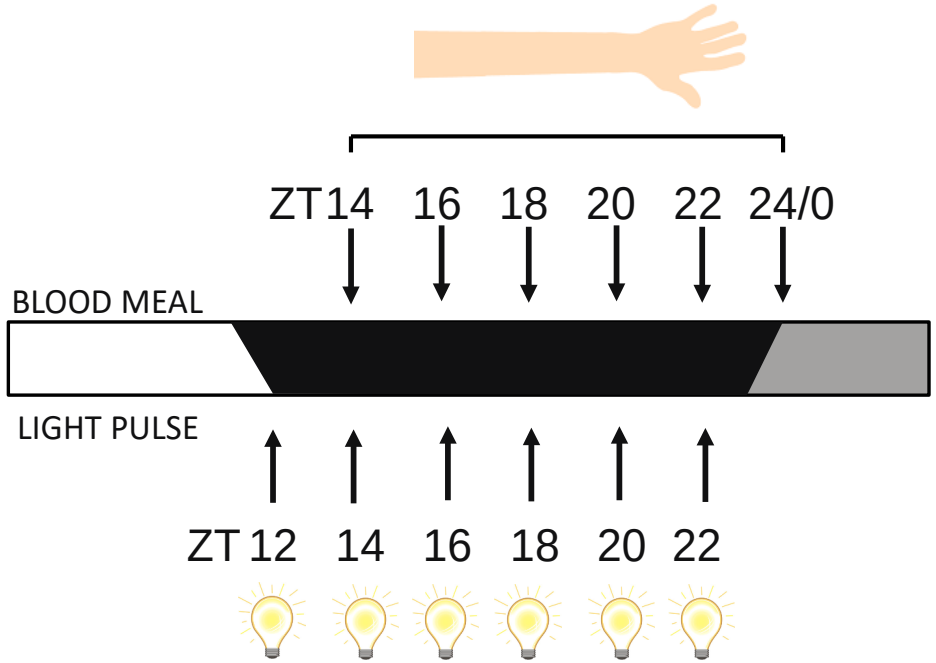
(single 10 min pulse 300 lux;
each batch of mosquitoes received a single pulse)



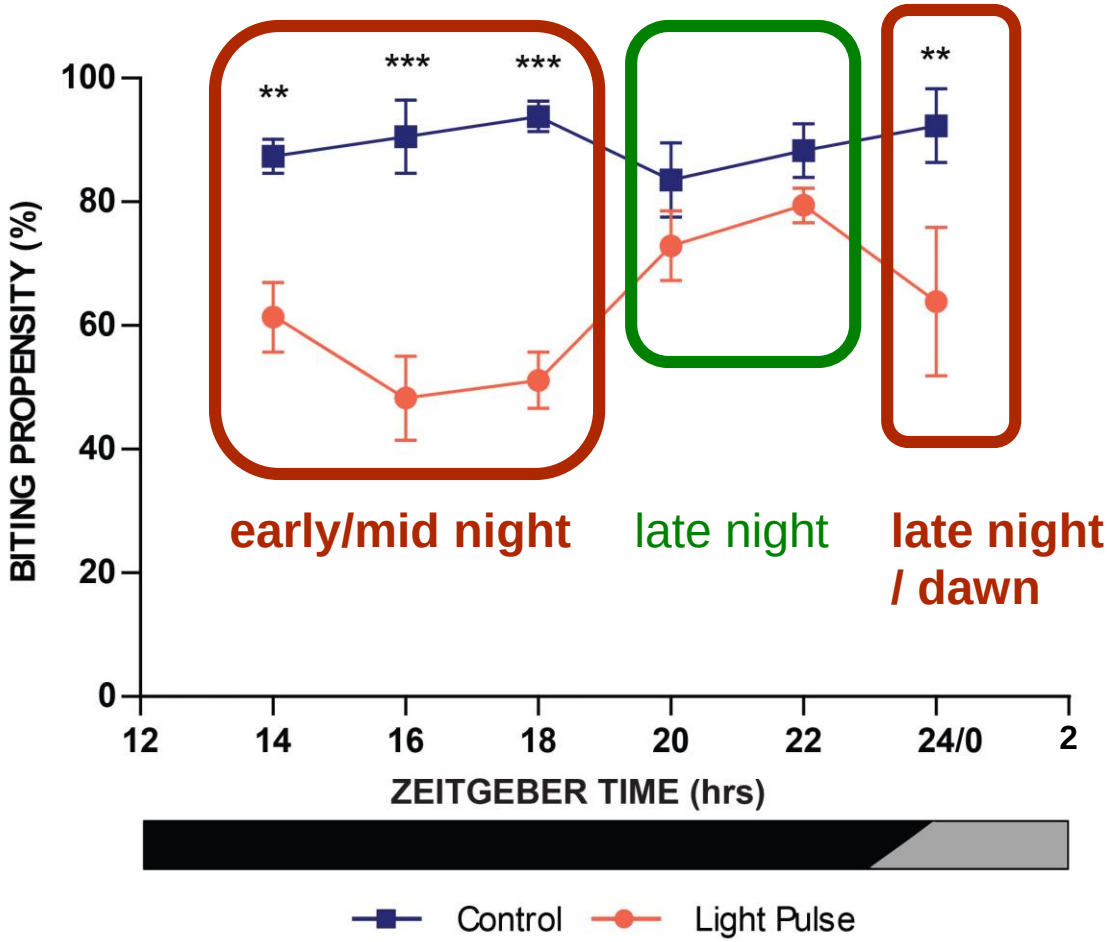
Incremental decline of suppression as night progresses

Exposure to *repeated* pulses of light result in *sustained* biting inhibition during the night

(biting assay in the dark before next light pulse)



(multiple pulses separated by 2 hr intervals of dark)



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- **Multiple pulses** of light with long 2 hr intervals could be an efficient method to suppress biting activity, especially indoors: This could **augment** current barrier and insecticidal strategies used to control mosquito-human interaction.

Acknowledgements

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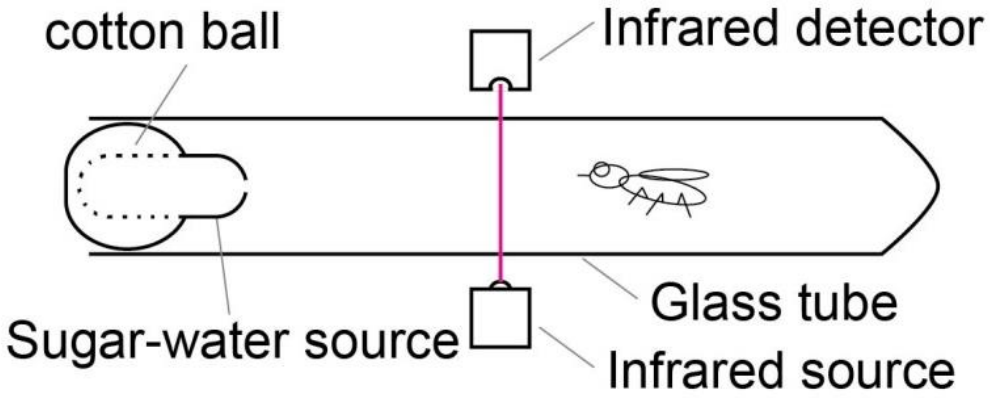
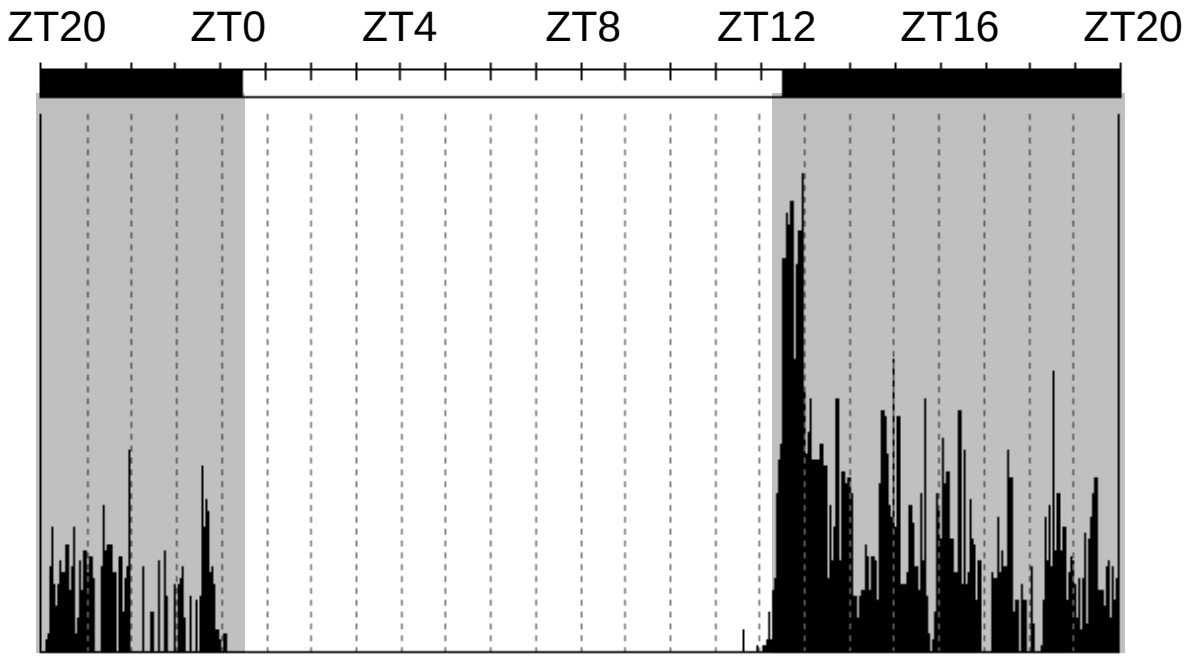
Monitoring of individual mosquito locomotor/flight activity

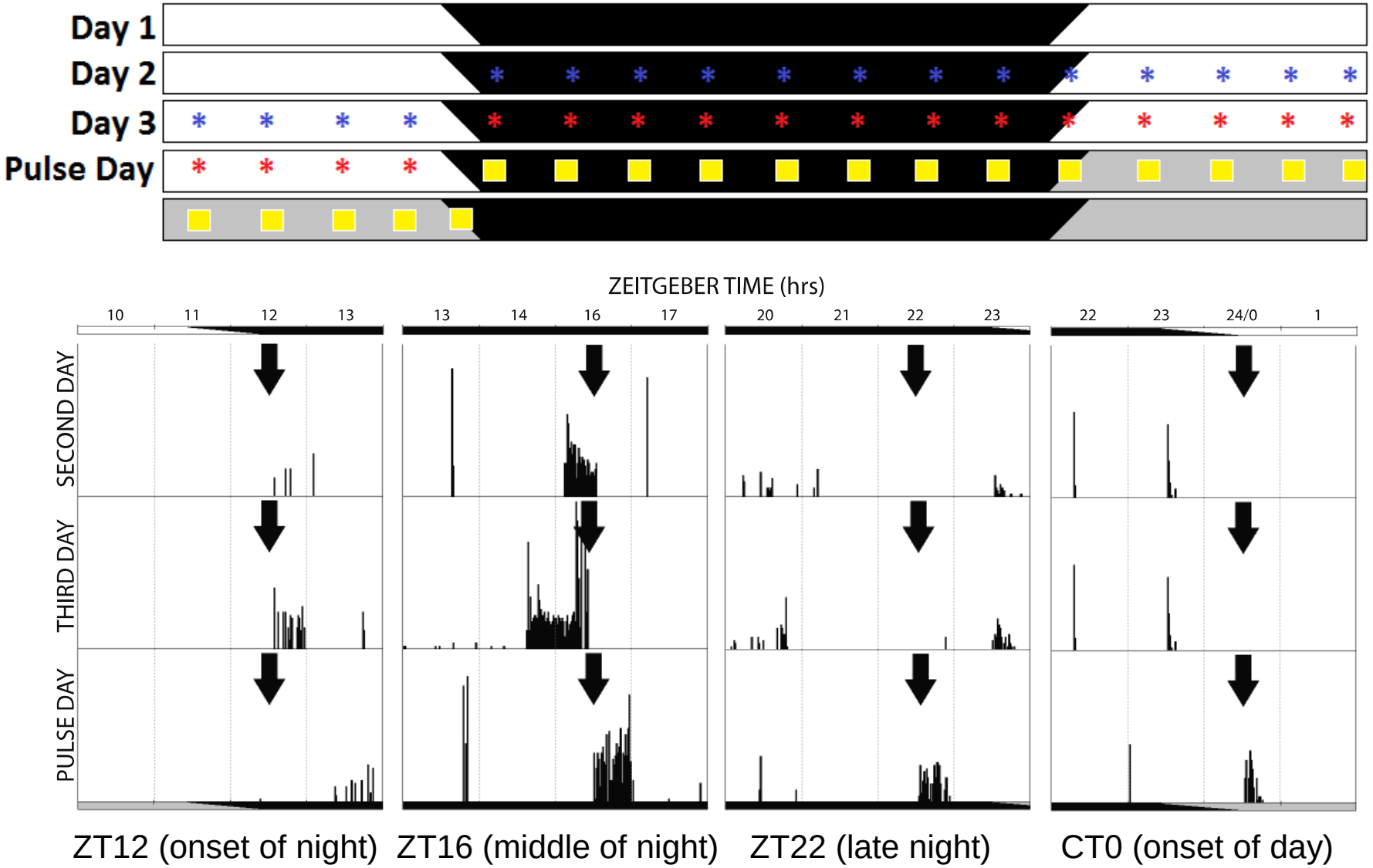




Flight activity is a component of host-seeking behavior

Method: Rund *et al*. 2012, *J. Insect Physiology* 58: 1609-19

Flight activity in female *An. gambiae* is modulated *during* a single 30 min light pulse



Locomotion/flight activity is modified by photic stimuli in an *immediate* and *time-specific* manner