

# Impact of LED floodlight on the activity range of the common European glow-worm, *Lampyris noctiluca*

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2016

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**INTRODUCTION** The female Glowworm *Lampyris noctiluca* uses a special strategy to attract males. Unlike the male counterpart the females do not have the ability to fly but have the ability to allure the males with their glowing posterior. The common European glow-worm belongs to a species which is influenced by the artificial light produced by humans through street lighting and other sources of light. On one hand the males are attracted by a specific light emission from a low-pressure sodium (LPS) lamp (Bek 2015). On the other hand females located under the scattered light of lamps can not be found by *L. noctiluca* males. The artificial light acts as a barrier (Ineichen, Rüttimann 2012). This influence was the main focus of this research. The aim was to get new findings on the effect of LED light on the distribution of *L. noctiluca* males and how they are influenced by LED floodlight of 5 lux, 20 lux and 60 lux.

**METHODS** The field study was conducted between May 20 and June 10 2016 on an open meadow at the Wehrenbachtobel in Zurich which was used as a rifle shooting area in the past. This location is known for a high number of *L. noctiluca* and has been used for different field studies before (Ineichen 2004). With a stimulus, a green LED light, it was tested if *L. noctiluca* males would find a female under the influence of a LED floodlight. During the test different illuminances and – in an additional step – different spectral compositions of 3000 Kelvin (warm light) and 5000 Kelvin (cold light) were used. As a reference point a LED trap was also placed without a flood light (0 lux).

In a first series of tests 5000 Kelvin floodlights of 60 lux and 20 lux over the LED trap (faking a female) were compared (May 22 – May 28).

In a second series a 3000 K floodlight of 20 lux and a 5000 K floodlight of 20 lux were compared, again over a LED trap (May 30 – June 6).

In a third series a 3000 K floodlight of 5 lux and a 5000 K floodlight of 5 lux were compared over a LED trap (June 5 – June 10).

In all three series the two floodlights and the reference point without floodlight were placed in a line in a distance of 18 meters between the neighboring positions. The tests were started when the females began to glow or at 10 p.m. the latest. Three runs were conducted each day of the research. Each test was during 20 minutes. Then the positions of the lights were exchanged to exclude local influences. The maximum amount of *L. noctiluca* in the traps was counted including a range of 25 centimeters around the LED trap simulating the glowing female.

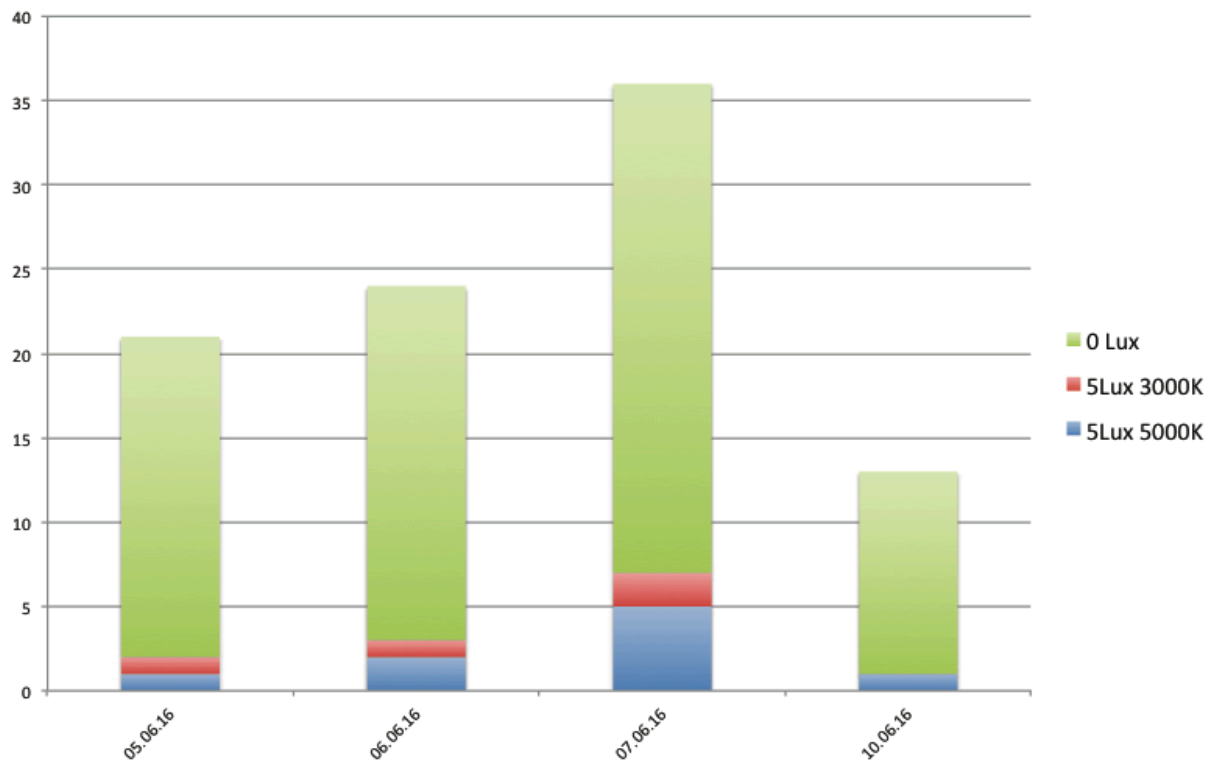
**RESULTS** During 15 days 257 males were counted overall the tests. The first encounter of flying males occurred when the surrounding temperature exceeded 13° C.

The first test series comparing the situation under illuminances of 60 lux and 20 lux resulted a total avoidance of the illuminated traps while the control LEDs without floodlight attracted a total of 52 males.

The second series comparing warm and cold light LED floodlights of 20 lux produced similar results: no males under 5000 K floodlight respectively 3 males under 3000 K lamp in contrast to 108 males counted around the control LED trap. The three males found one evening underneath the 3000

floodlight were not moving at all and were staying fixed on one point until they were released when the position of the flood lights were switched.

In the final test series, where 5 lux once with 3000 and once with 5000 K was compared, the rate of arriving males underneath the flood lights was at 13.8% of the total observed males (94). The amount of caught *L. noctiluca* was with 9 higher beneath the cold flood light (5000 K) than beneath the 3000 K lamp (4 males), although no significant difference resulted.



**Figure 1** Numbers of *L. noctiluca* males around LED traps counted during the third test series comparing additional 5 lux illumination with floodlights of warm light LED (3000 K, red bars) and cold light LED (5000 K, blue bars). Most males were attracted by traps situated in the dark (green bars.)

**DISCUSSION** A direct approach to the flood lamps like Bek (2015) describes as an effect of low-pressure sodium lamps (without female simulating LED traps!) was not noticed on the LED flood lights during the whole research – a result confirming the studies of Bek showing an attraction almost only under LPS lamps emitting monochromatic light in the wave length of 589.3 nm, close to the maximum emission of bioluminescent glowworms. The avoidance of strong light cones of street lamps as noticed by Ineichen and Rüttimann (2012) is confirmed by this field study. This research shows that in a LED Light range over 20 lux the female *L. noctiluca* can not be found by males. By a reduction to 5 lux on ground level there is still a reduced amount of approaching males compared to the reference, but the females can be found at least by some of the males. Further studies are required to approve these findings and explore the threshold of the light emission further.

## REFERENCES

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