

ATTRACTION OF MODERN LIGHT SOURCES FOR NOCTURNAL INSECTS

a study of the Tyrolean State Museums and the Office of the Tyrolean Environmental Ombudsman



Problem

Artificial lighting took over the open land in the last decades. This has brought plenty of ecological consequences. Especially nocturnal insects, migrating birds and presumably a lot of other animals are affected. This so called “light pollution” has further serious impacts on human health, the visibility of the night sky and finally lots of energy is emitted unused.

The purpose of the study is to identify the most insect-friendly light sources and investigate their photometric properties.

Awareness of the problem

Nocturnal insects use the light emitted from celestial bodies for orientation. Such animals are dazzled by artificial light sources and lose their sense of orientation. They fly automatically to the light source and circle it until they die of exhaustion or burn. Such situations deprive billions of insects of their habitats, including some that are classified as threatened or endangered species. In the end artificial light is one of the many factors for biodiversity loss.



Fig. 1 Collected insects (Lepidoptera)



Fig. 2 Building the traps

Methods

In June, July and August 2010 and 2011 field studies were conducted in Völs (Tyrol, Austria). During 18 nights each year, alternating between six sites in a homogeneous forest habitat, six lighting fixtures of comparable output and used for exterior lighting were tested for their power to attract nocturnal insects.

In 2011 two LED lights with different color temperatures (neutral white and warm white) and a high pressure sodium lamp (NAV) were tested, at which the main focus was set on both a clear and a diffuse emitting trap with comparable lighting parameters. Main requirements for the field studies were the alteration and calibration of the traps by the company Bartenbach GmbH to achieve comparable emitting surfaces using a LEE film, average luminance and luminous flux.



Results

The insect attraction of the tested illuminants is significantly lower with LEDs. Warm white LEDs (3000 and 2700 Kelvin) obtained the best results. LEDs outperform high pressure sodium lamps (NAV) by 40-60 % in 2010 and 2011. Metal halide lamps have a very high attraction effect on insects.

Furthermore the field study of 2011 proves that concerning the attraction effect it doesn't matter whether the total luminous flux is emitted through a large diffuse luminescent surface with a low luminance or several small luminescent surfaces with very high luminance. The total amount of insect approaches to diffuse luminescent surfaces is just slightly higher than the amount of insect approaches to clear luminescent surfaces.

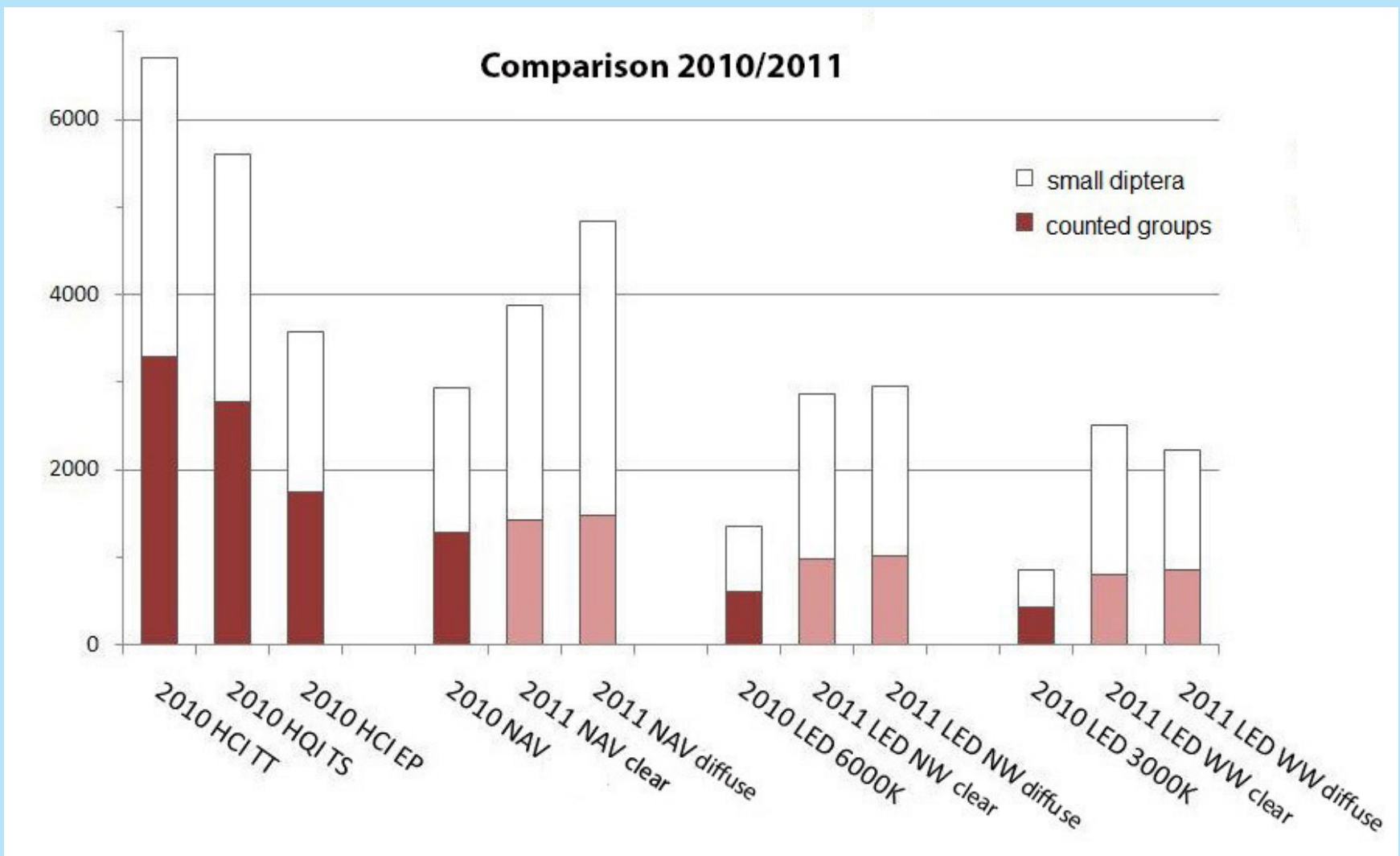


Fig. 10 Attraction on insects of the lamps tested in 2010 and 2011

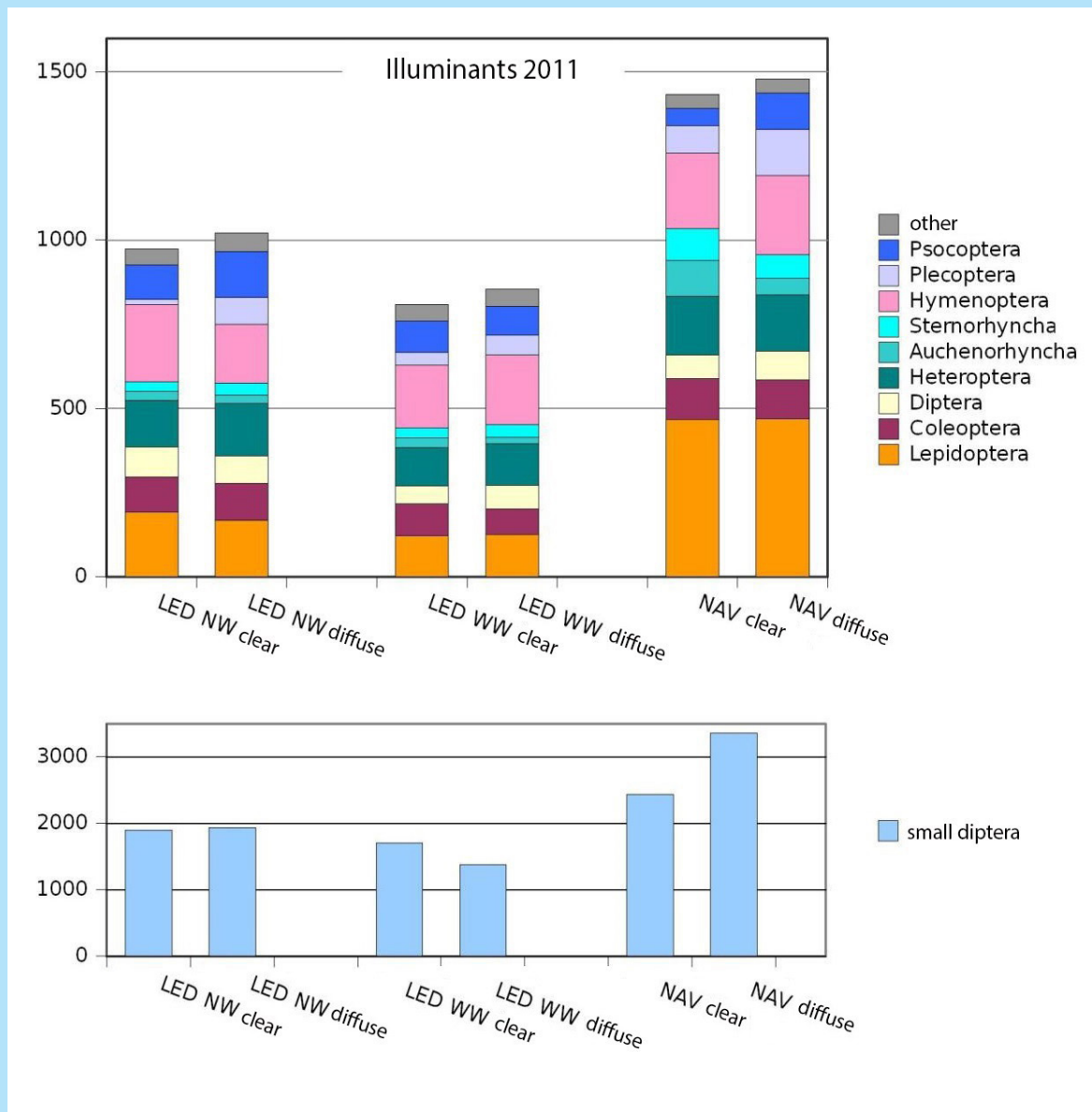


Fig. 11 Attraction of the tested lamps to the different insect groups

year	2010	2011	reference lamp 2010 & 2011	2011	2011	2011	2011	2011	2011
type	HQ-TS high pressure metal halide lamp with quartzburner	HQ-TT high pressure metal halide lamp with ceramicburner	HQ-TT high pressure metal halide lamp with ceramicburner	LED	LED	NAV-T high pressure sodium lamp clear	NAV-T high pressure sodium lamp clear	LED warm white clear	LED neutral white clear
color temperature (Kelvin)	5600 K	3000 K	4200 K	6000 K	3000 K	2000 K	2000 K	2700 K	2700 K
luminance (lux)	4999 lux	4235 lux	4176 lux	2285 lux	2217 lux	5066 lux	-	-	-
average luminous flux (Lumen)	-	-	-	-	-	6600 lm	5023 lm	6684 lm	5087 lm
power (Watt)	78 W	74 W	73 W	2x25 W	2x25 W	70 W	-	-	-
light emitting surface	-	-	-	-	-	355x10 ³ mm ²	157 mm ²	355x10 ³ mm ²	157 mm ²
average luminance emitting surfaces	-	-	-	-	-	3,5x10 ⁶ cd/m ²	4500 cd/m ²	13,4x10 ³ cd/m ²	4557 cd/m ²
area luminance	-	-	-	-	-	3,5x10 ⁶ cd/m ²	4500 cd/m ²	13,4x10 ³ cd/m ²	4557 cd/m ²
irradiance	18,4 W/m ²	14,9 W/m ²	16,5 W/m ²	7,6 W/m ²	6,5 W/m ²	16500 cd/m ²	13,4x10 ³ cd/m ²	6500 cd/m ²	13,4x10 ³ cd/m ²

Fig. 12 Technical data of the tested illuminants 2010 and 2011



Fig. 13 There is a 10 meters (about 33 feet) distance between the traps

Conclusion

The **most insect-friendly light source** tested in the studies was found to be the **warm white LED lamp** (2700 Kelvin).

Recommendation

Light sources must satisfy the criteria of **energy efficiency** (high luminous efficacy), **long service life** and a **low or zero proportion of ultraviolet and infrared radiation**. Recommended options are:

- LED (colour temperature warm white < 3000 Kelvin)
- NAV high pressure sodium lamp

Also light fittings must satisfy the criteria of **targeted lighting** so as to avoid light scatter and glare.

- Full cut-off luminaires (fully shielded light fittings)
- Reduced mounting height
- Targeted light control through correct installation and the use of suitable reflectors, flat diffusers (discharge lamps), intelligent optic design (LEDs), enclosed housings, and fittings with low surface temperatures

Literature

[1] Huemer, P., Kührtreiber, H., Tarmann, G., 2010. Anlockwirkung moderner Leuchtmittel auf nachtaktive Insekten. Ergebnisse einer Feldstudie in Tirol (Österreich). Erschienen in: Tiroler Landesmuseen Betriebsgesellschaft m. b. H. (Hrsg.), 2011. Wissenschaftliches Jahrbuch der Tiroler Landesmuseen 2011. S. 110-135.

[2] Huemer, P., Kührtreiber, H., Tarmann, G., 2011. Anlockwirkung moderner Leuchtmittel auf nachtaktive Insekten. Feldstudie 2011. Innsbruck: Tiroler Landesumweltanwaltschaft & Tiroler Landesmuseen Betriebsgesellschaft m. b. H.

[3] Laner, M., 2011. Lichttechnischer Abschlussbericht der Insekten-Anlockfallen. Einsatz in der Leuchtmittel-Feldstudie in Tirol. Aldrans: Bartenbach Lichtlabor GmbH.

[4] <http://www.plightwithlight.org>

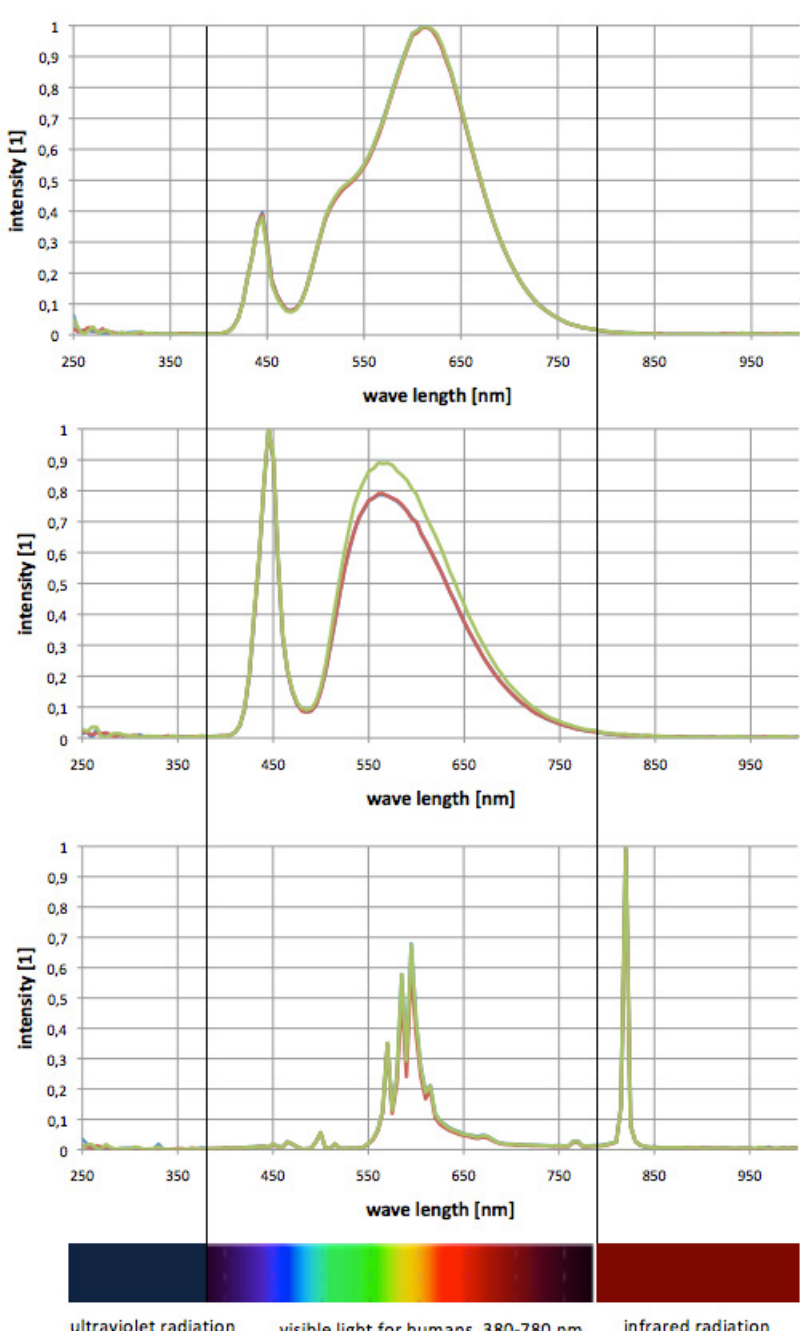


Fig. 3 Spectral measurement of the lamps tested 2011

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