BioAdaptive

by Focus Lighting

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BioAdaptive Lighting – Friendly Lighting for Fauna, Flora and People
BioAdaptive Lighting offers biologically friendly solutions designed to support fauna, flora, and people. The goal is to enhance biodiversity by protecting wildlife and ecosystems through considerate and adaptive use of light.

Traditionally, outdoor lighting has focused on human needs such as navigation and safety. With BioAdaptive Lighting, we expand this perspective creating solutions that balance functionality for people with the biological requirements of nature.

Space BioAdaptive Warm

BioAdaptive Lighting

Understanding the Light Spectrum

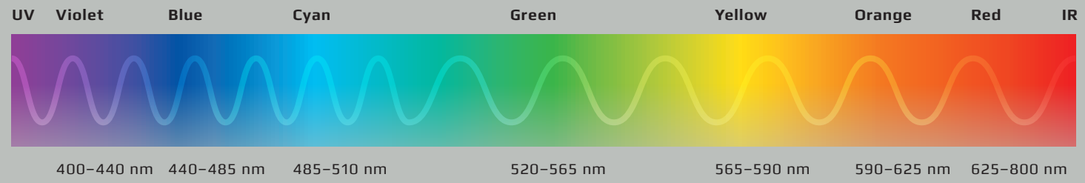
Nyx 330 BioAdaptive Warm

Visible light for humans spans wavelengths from approximately 400 nanometers (violet) to 800 nanometers (red). Each wavelength corresponds to a different color, and this distribution has significant biological effects on all living organisms — not just humans.

Circadian rhythms, the natural cycles that regulate biological processes such as sleep, feeding, and reproduction, are heavily influenced by light and darkness.

Research shows that animals and insects are particularly sensitive to short wavelengths, especially blue light below 520 nm, which strongly affects their biological clocks.

Visible Spectrum



Light Options Available in BioAdaptive Lighting

Warm (3000K–1800K)
Balanced human comfort and visibility; low blue content.

Amber (≈585–600 nm)
Suitable for sensitive natural areas with a narrow spectrum in Amber.

Red (≈655–675 nm)
Very narrow red spectrum and suitable for sensitive habitat areas.

Dim-to-Warm (2900K–1800K)
Warmer color temperatures when lighting is dimmed.

The Role of M-DER in Lighting Design

The International Commission on Illumination (CIE) defines the Melanopic Daylight Efficacy Ratio (M-DER) as a measure comparing daylight with LED light sources. The circadian rhythms follow daylight patterns, with peak blue content during bright daylight hours. An M-DER value of 1 corresponds to daylight at 6500K (CIE D65).

For BioAdaptive Lighting, the aim is to minimize blue light exposure by using sources with low M-DER values. For example, warm color temperatures (2200-1800K) typically have much lower M-DER levels than commonly used 4000-3000K light sources.

In conventional lighting, a high color rendering index has been regarded as a positive quality. However, an LED light source with CRI 70 actually has a lower M-DER value than one with CRI 80. Warmer color temperatures, such as 1800K and 2200K, have an even more significant impact on reducing M-DER values. This contributes to the shifting perspectives and new ways of balancing lighting for fauna, flora, and people.

In Denmark, road lighting standards recommend M-DER values below 0.35, which points to solutions of maximum 2700K and CRI 70. For sensitive habitats requiring special protection, the target is even stricter — M-DER below 0.3.

BioAdaptive Lighting

Reducing light for Biodiversity

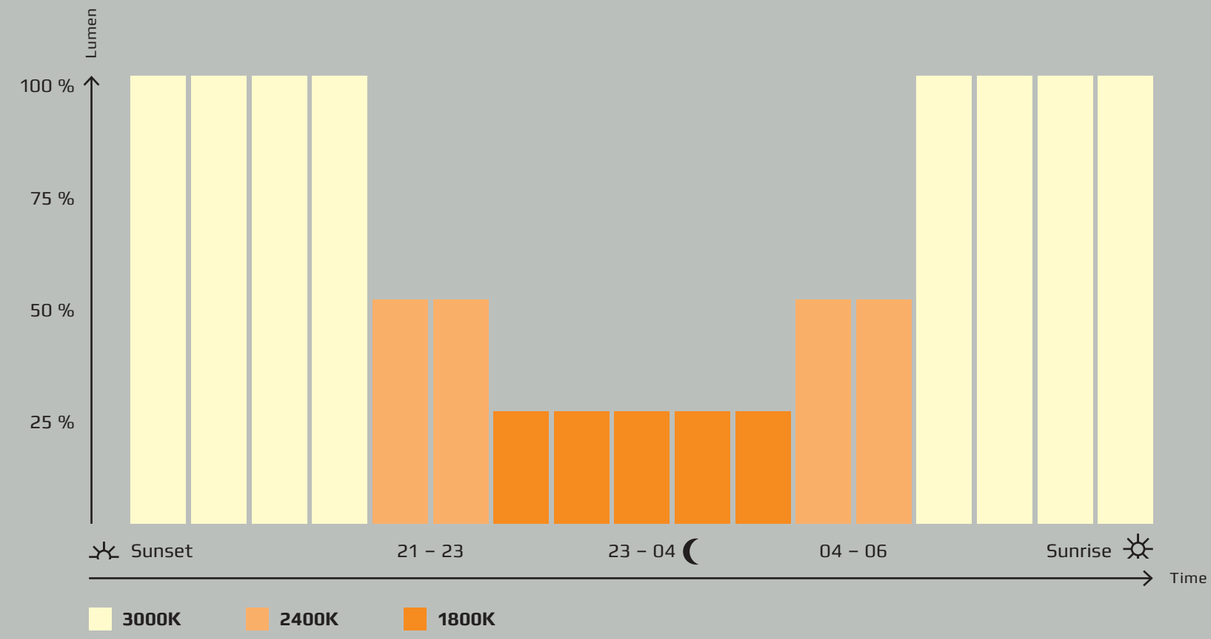
Space BioAdaptive Warm 2400K

Many species are far more sensitive to light than humans, and even low levels of light can disturb their circadian rhythms. Reducing illumination at night is therefore a critical aspect of creating biologically friendly environments.

A simple consideration is whether a standard lighting level of 3 lux could be reduced to 1 lux — or even lower — at nighttime. In some cases, lighting may be switched off entirely and only reactivated by motion sensors.

A respectful lighting solution requires adaptive tools that balance human safety with biological impact.

Night-time dimming profile



Adaptive control options for BioAdaptive Lighting

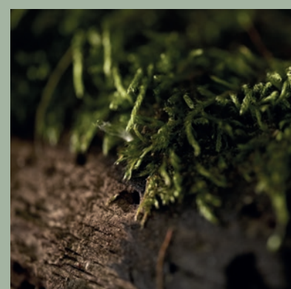
Night-time dimming profiles
Stand-alone dimming with pre-programmed dimming at night-time, i.e. reducing lighting levels and adjusting color temperatures.

Pre-set spectral shift control
Stand-alone dimming with pre-programmed shift of color spectrum, e.g., using 2700K until 22:00, switching to monochrome Red or Amber LEDs at night, and re-turning to 2700K in the morning.

Sensor-based adaptive operation
Motion sensors to dynamically adjust intensity or spectrum. Sensors can be connected via downward-directed Zhaga D4i nodes on the luminaire.

Remote control and system integration
Zhaga D4i remote control for full control of lighting levels, color temperatures and even flexible adaptations throughout the year.

Balancing human comfort with respect for biodiversity



Four Product Solutions

BioAdaptive Warm (BW)

BioAdaptive Warm provides adaptable lighting with brighter light in the early evening (3000–2700K) and dimming down at night (2200–1800K) to benefit both fauna and flora.

BioAdaptive Amber (BA)

BioAdaptive Amber is a combination of LEDs in 2700K and monochromatic Amber with a spectrum of 585–600 nm. The amber LEDs contain no blue or cyan wavelengths. Switch between 2700K (evening and morning) and Amber (nighttime).

BioAdaptive Red (BR)

BioAdaptive Red is a combination of LEDs in 2700K and monochromatic Red with a spectrum of 655–675 nm. The Red LEDs contain no blue or cyan wavelength. Switch between 2700K (evening and morning) and Red (nighttime).

BioAdaptive Dim-to-Warm (BDW)

BioAdaptive Dim-to-Warm is ranging from 2900–1800K, and is a more simple solution with single-channel control, meaning that dimming to 1800K also reduces the overall light output simultaneously.

Product Solutions

BioAdaptive Warm (BW)

3000K 2700K 2400K 2200K 1800K

Space BioAdaptive Warm

BioAdaptive Warm
Suitable for public spaces, street lighting, parks, and general outdoor environments where M-DER values are critical.

BioAdaptive Warm provides:

+ Adjustable CCT from 3000K to 1800K
+ Lumen levels ranging from low to high
+ Two channel driver (DT8) for separate control of color temperature and lumen
+ Stand-alone operation with pre-programmed dimming and Kelvin profiles
+ Options for both Zhaga D4i remote control and D4i sensor integration

BioAdaptive Warm CCT examples

Luminaires offered with BioAdaptive Warm

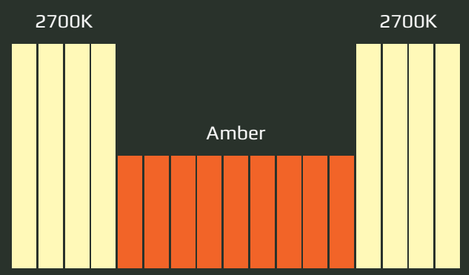
Product Solutions

BioAdaptive Amber (BA)

2700K Amber


Nyx 330 BioAdaptive Amber

BioAdaptive Amber
Suitable for sensitive habitats where Amber light supports and protects sensitive ecosystems.

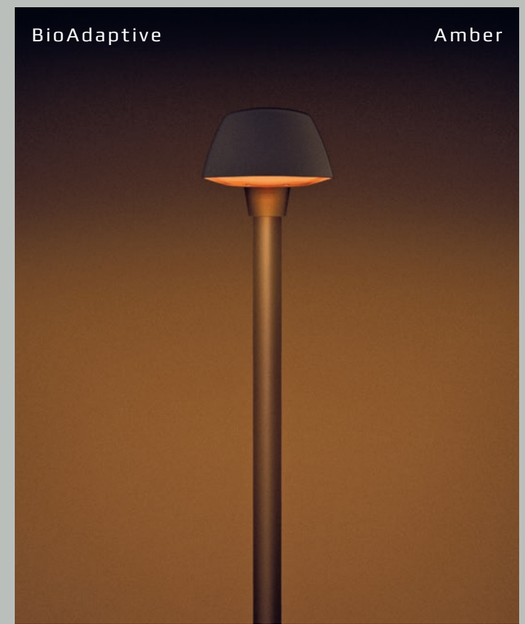


Night-time dimming profile

BioAdaptive Amber provides:

+ LEDs in 2700K and Amber on the same board
+ Amber spectrum primarily at 585–600 nm
+ Lumen levels ranging from low to high
+ Two-channel driver (DT8) for separate control of color temperature and lumen
+ Stand-alone operation with pre-programmed dimming, enabling choice between 2700K or Amber
+ Options for both Zhaga D4i remote control and D4i sensor control

BioAdaptive 2700K and Amber Spectrum examples



Luminaires offered with BioAdaptive Amber

Nyx 330

Nyx 450

Way

Peak 320

Peak 380

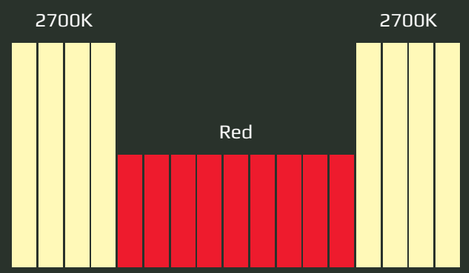
Product Solutions

BioAdaptive Red (BR)

2700K Red

Nyx 330 and Nyx Bollard BioAdaptive Red

BioAdaptive Red
Ideal for sensitive natural habitats where monochrome red light supports and protects sensitive ecosystems.

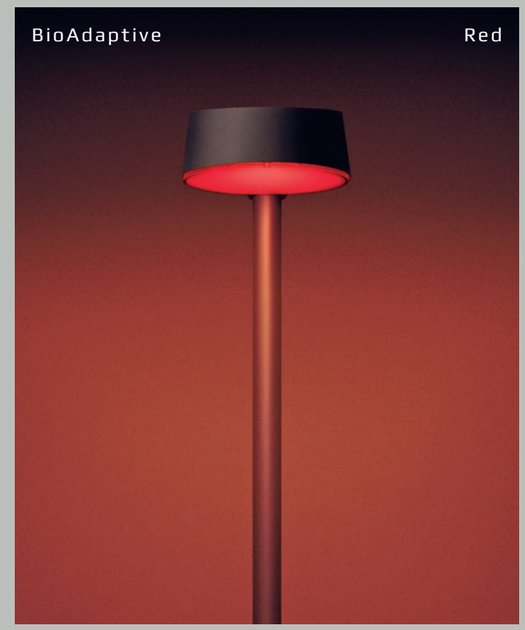


Night-time dimming profile

BioAdaptive Red provides:

+ LEDs in 2700K and Red on the same board
+ Monochrome Red spectrum primarily at 655-675 nm
+ Lumen levels ranging from low to high
+ Two-channel driver (DT8) for separate control of color temperature and lumen
+ Stand-alone operation with pre-programmed dimming, enabling choice between 2700K or Red
+ Options for both Zhaga D4i remote control and D4i sensor control

BioAdaptive 2700K and Red Spectrum examples



Luminaires offered with BioAdaptive Red

Product Solutions

BioAdaptive Dim-to-Warm (BDW)

2900K 1800K

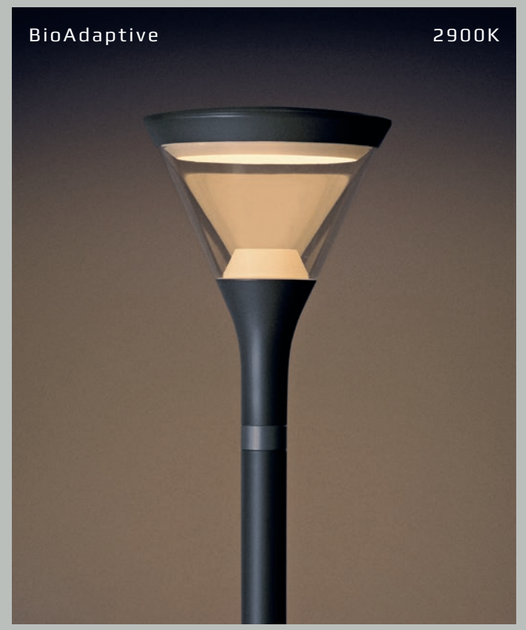
Sky Park and Turn BioAdaptive Dim-to-Warm

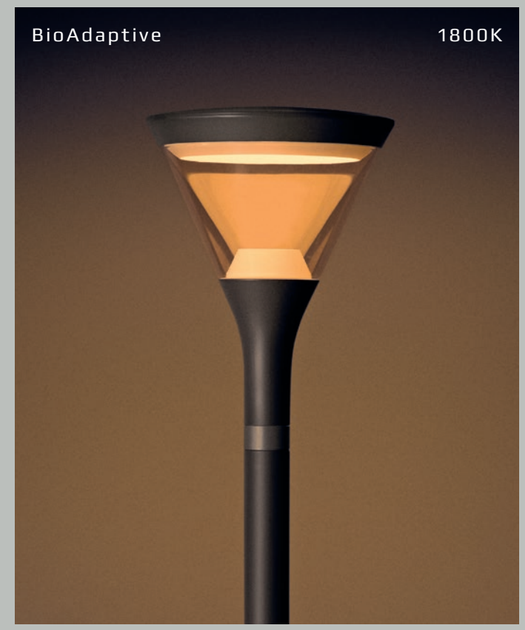
BioAdaptive Dim-to-Warm
An easy-to-implement solution for public areas, parks, and general outdoor lighting where simple, adaptive Dim-to-Warm performance is desired.

BioAdaptive Dim-to-Warm provides:

+ Adjustable CCT from 2900K to 1800K
+ Simultaneous dimming of color temperature and lumen output
+ One-channel driver for simplified control
+ Stand-alone operation with pre-programmed dimming profiles
+ Options for both Zhaga D4i remote control and D4i sensor integration

BioAdaptive Dim-to-Warm CCT examples





Luminaires offered with BioAdaptive Dim-to-Warm

Nyx 330 BioAdaptive Warm

Case Story

Gladsaxe Municipality

Nyx 330 and Nyx Bollard BioAdaptive Red

Product
Nyx BioAdaptive Lighting Red

Case
Road and Bicycle Path lighting
in a protected bat-area habitat

Client
Gladsaxe Municipality

Lighting Designer
Light Bureau

The lighting along Frederiksborgvej near Skovbrynet in Gladsaxe is designed to ensure traffic safety for cars and cyclists while protecting bats and local biodiversity. A BioAdaptive Red lighting system has been implemented along the 700-meter stretch to safeguard a nearby bat colony.

Research shows that blue and white light disturb bats, while red light does not disrupt their habitats. Therefore, light corridors have been established to support light-sensitive species without compromising visibility for cyclists.

The project balances safety, biodiversity, and sustainable urban development in line with Gladsaxe Municipality's SDG strategy.

BioAdaptive Lighting – A new Perspective on Outdoor Lighting

BioAdaptive Lighting introduces a new perspective on outdoor illumination — where light not only serves human needs but also respects and supports biodiversity. Through spectrum control, dimming strategies, and intelligent adaptive technologies, it is possible to create more sustainable, and biologically friendly environments.

Nyx 330 BioAdaptive Warm

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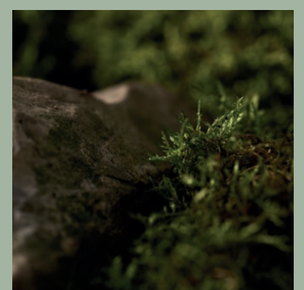

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