

THE BIODIV System

We warmly thank for the development of the color chart, Concepto for project photos, as well as the internal teams for their commitment to this project.





As a young company in the field of lighting (even if we have taken over an older asset), it seemed obvious to integrate a human centered approach, coupled with a environmental preservation logic.

The developed **BIODIV SYSTEM** has been designed to respect all occupied areas in terms of :

- crossing frequency, service to users,
- fauna and flora preservation,
- local identity through a wide choice of product aes-

thetics.

We thus wish to offer you the possibility of answering as precisely as possible to the different types of areas. This is a first offer that we will develop with the technology, our R&D and your needs.

A FEW KEY-DATES

THE PRESERVATION OF BIODIVERSITY HAS BECOME A MAJOR ISSUE AND CHALLENGE FOR OUR PLANET AND THUS FOR THE LIGHTING SECTOR.

1995 / GREEN AND BLUE INFRASTRUCTURES

The Green and Blue infrastructures (GBI) was born in France in 1995, to respond to the desired creation of a pan-European ecological network, decided by the members of the Council from Europe.

Since 2007, it has been officially considered as one of the major projects, stemming from the Environment Grenelle.

GBI is precisely defined in the French environmental code, and it ensures maintaining and improving ecological continuities, guaranteeing the proper functioning of natural environments.

It is part of the preservation of biodiversity, through reservoirs of bio-diversity and ecological corridors*, and it has become an important planning tool for land use beyond all administrative rules.

2011 / DARK INFRASTRUCTURES

Initially, the nocturnal dimension of the GBIs had not been taken into account.

The first dark infrastructure study appeared in 2011 in Rennes in France, under the impetus of the lighting design agency CONCEPTO, during the realization of the Lighting Master Plan (LMP) of the city. Dark infrastructure studies are now in full development, generally integrated into Lighting Master Plan studies.

At that time, it was a question of expressing a strategic desire to couple luminous atmospheres and a network of darkness, and to create a Light-Dark gradient, geographically and temporally, and to complete the development strategy of a site by focusing particularly on the fringes and edges created around obscure territories.

It also made it possible to characterize a certain darkness for the ecological corridors used by nocturnal species and thus to aim to limit and fight against light pollution which negatively influences animal species and threatens the biodiversity.

It has only been in recent years that it has established itself in the LMP as an essential complement for the preservation of nocturnal animal species.

It strikes a virtuous balance between light and darkness, between humans and animal species and plants.

* Biodiversity reservoir: space which presents a remarkable biodiversity and in which live heritage species to be safeguarded



STRUCTURE & RECOMMENDATIONS FOR DARK INFRASTRUCTURES

The dark infrastructure is studied, designed and broken down into sectors and sub-sectors which take into account:

- Local animal and plant species
- The location of natural areas (forest, agricultural or leisure)
- Sensitive areas flood-prone areas, sites of ecological interest and forests
- Identified ecological corridors
- Different horizontal or vertical occupation layers depending on the species (birds, bats, mammals, insects, etc.).

FOR EACH SECTOR AND SUB-SECTOR, LIGHTING REQUIREMENTS Installation methods, specifical devices And sources are recommended.



8

THE BIODIV SYSTEM A MODULAR TECHNICAL RESPONSE



Until now, there were neither technical tools nor means made available to clients, nor project management to support the recommendations resulting from the implementation of dark infrastructure.

The BioDiv constructive system offers the necessary modularity to respond to this diversity of specific nocturnal needs.

It proposes to combine spectra of LEDs selected with precision (tone of light and colors) with optics adapted to the area and to control its sources separately according to the needs.

The mixes thus produced allow creations and renovations of lighting installations while minimizing the impact on nocturnal biodiversity.

9



IN TERMS OF LIGHTING What are the issues and Area Arrangements.

VARIED NIGHTTIME USES AND MULTIPLE NEEDS

The lighting of a square, a park, a roadway, a sidewalk, a cycle path, an alley or an outdoor car park, must today be framed as precisely as possiblepossible on the surfaces to be illuminated to both encourage human activity and preserve a maximum of penumbra and / or darkness, necessary to biodiversity development.

It is usual, in the organization of public areas :

• To differentiate the tone of light from the lighting. Warmer light near planted areas, as soon as it is switched on or in the heart of night.

• Opt for colored light (strictly selected LED spectrum)on specific areas to preserve local animal species.

• To play on the intensities of these lightings, according to nighttime needs. Reduce or turn off at dusk and dawn when animal activity is high and in the middle of the night when human traffic is less or nonexistent. Reduce or switch off depending on the passage of users (vehicles, pedestrians and/or cyclists)

Hence the importance of being able to choose the photometries of the lighting devices, the quantity of luminous flux emitted and to have the possibility of controlling and differentiating the lighting of the LED blocks, depending on the configurations of the areas and the nocturnal uses.

THE BIODIV SYSTEM ALLOWS A WIDE RANGE OF POSSIBLE CONFIGURATIONS, Allowing areas to be managed from the same luminaire with differentiated temporalities and seasonalities.

THIS IS THE POSSIBILITY OF BUILDING A PRECISE RESPONSE Adapted to each space with the same luminaire.

EXAMPLES OF SPACE AND TIME SECTORIZATIONS:



Scenario example: Cycling lane in warm white 2700K Pedestrian lane in yellow with a selected spectrum for birds and bats preservation.







Low traffic period 2200K before switching-off



Traffic period <u>Scenario example of a cycling lane:</u> While detected: 2200K Stand-by period from 5.00 pm until 1.00 am in winter – red Switched-off between 1.00 am and 5.00 am



Standby period

THE BIODIV System

WAS DEVELOPED FOR A TOTALLY **F L E X I B L E** USE





Animal species react very differently to colors and tonalities of light from artificial lighting:

Most mammals are sensitive to two types of wavelengths. (green, blue). Primates and humans are sensitive to three types of wavelengths (red, green, blue). Most vertebrates like fish, reptiles and birds are susceptible to four types of wavelengths. (red, green, blue, UV).

A number of animal species (such as birds, for example) are also very sensitive to UV rays unlike humans who do not perceive them.

Other animals are able to detect electromagnetic radiation located in the infrared. A large majority of invertebrate species and a significant part of vertebrate species are nocturnal.

Artificial lighting also impacts the rest, behavior and practices of diurnal species.

The objective is to select a spectrum that will not or rarely be visible to the species aimed to be preserved.





THE DIFFERENT COLOURED LIGHTS AND LIGHT TONES USED IN A LIGHTING PROJECT IF NOT CAUTIOUSLY SELECTED, , CAN SERIOUSLY THREATEN MANY ANIMAL SPECIES AND BE LETHAL FOR SOME OF THEM.



OUR ANSWER

CHOICE OF LEDS, SHADES AND COLORS WITH THE ADAPTED AND SELECTED LED SPECTRA.

It is therefore essential today to:

- Choose white light tones carefully
- Choose and select LED light colors

 \bullet Combine or mix the LEDs according to the animal species present on the illuminated site $^{(\mathrm{l})}$

In order to disturb them as little as possible and to respect their biological rhythms and their behaviour, while maintaining a quality of light necessary for the various required uses and human nighttime needs.

In some cases, and given the diversity of the animal species present on site, it will be needed:

> To choose the coloured light or the least impacting tone of light for the majority of species present on the site area.

> To think carefully about the areas that really need lighting

> To minimize the lighting time as much as possible at the beginning and at the end of the night (at the time peak activity of nocturnal animal species), during the night and according to seasons, to adapt to the habits and needs of the animal concerned species.

SCALABLE EVOLUTIVE LIGHTINGS WILL MAKE POSSIBLE TAKE INTO ACCOUNT DIFFERENTS HABITS AND NOCTURNAL NEEDS OF EVERYONE, HUMANS AND ANIMAL SPECIES.

(1) Consulting local biodiversity atlases of or recently inventoried nocturnal fauna will be always useful to geolocalize it.



Jardin Flaubert, Grenoble.

OUR SELECTION CHOOSING ONE'S SHADES

The objective is to select a spectrum not or rarely visible by the species aimed to be protected.

	OUR SELECTION of Light Colors According to the Fauna	GREEN	YELLOW	ORANGE	RED	CARMIN
	FISHES	X	\$	v	V	◊
*	SPIDER	V	X	X	X	X
	CRUSTACEANS	X	v	V	V	X
M	AMPHIBIANS	X	X	X	X	V
	REPTILES	◊	\$	V	V	V
V	BIRDS	X	v	◊	X	X
٩	MAMMALS Excepted bats	V	X	X	X	X
	BATS	X	X	V	◊	X
	INSECTS	◊	♦	V	V	>
	PLANTS	◊	v	v	\$	X

 \mathbf{X} = harmful spectra to avoid

 \diamond = low harmful spectra

¥ = less harmful spectra







K



Our available selection : : Ambre (1800K) - 2200K - 2700K - 3000K

Several studies have shown that most nocturnal animal species are strongly impacted by cold white light tones above 3000K, while they tolerated better warm or very warm light tones (from 2700K to 2200K). Indeed, the warmer the tone of light, the more the spectrum is composed of mainly yellow, orange and red rays of light.

It is therefore important to choose from the beginning of the lighting project, the desired tone of light, depending on the colours of the layout and the presence of animal species on the site, lower or higher, current or future.

It is also important to look at the spectrum of each chosen LED light tone, in order to analyze the rays peaks of blue or green light which can be harmful to certain animal species.

It must be recalled that since the publication of the French decree of December 27, 2018 against light pollution, light tones above 3000K are henceforth prohibited in urban lighting in France, to optimally preserve nocturnal biodiversity in the city.







We therefore analyzed and inventoried the spectra of the least harmful LED sources for the various animal species in order to be able to integrate them in different ways in our construction system and use them in our lighting solutions.

It is thus possible to equip lighting devices with LED blocks on request:

ONE SINGLE TONE

Single tone of white light (1800K, 2200K, 2700K, 3000K)



Two tones of light that will be switched on jointly or separatly depending on the desired uses and times (for example with a 3000K tone at the start of the night and 2200K in the middle of the night).

MIXED WHITE LED AND COLOURED LEDS

Mixed white LEDs and coloured LEDs (green, yellow, amber, orange or red),

SINGLE COLOUR

Unique colour with a spectrum adapted to different nocturnal animal species (amphibians, birds, mammals, insects, chiroptera), that will be activated alone at certain times of the night or or the year.

TWO COLOURS

Two colours once again adapted spectra.

BIODIV SYSTEM OUR SELECTION

WHITE TONES







BIODIV SYSTEM LIGHT TONE(S) AND COLOUR(S) TEMPERATURE(S) IN THE SAME EQUIPMENT

The way the LED units are distributed in the lighting device, parallel or perpendicular to its axis, also makes it possible to channel the luminous flux differently according to the desired light tones.



3 PCB CONFIGURATION	4 PCB CONFIGURATION

BIODIV SYSTEM AVAILABLE OPTICS

The exterior space is broken down into sub-spaces of different geometry and nature. With LED, the luminaire must precisely frame its luminous flux on areas to be illuminated. The residual flow must therefore be minimized or removed to avoid disturbing the animal and plant species located in the vicinity.

The choice of optics possibly coupled with flow-cutting systems is therefore paramount.

The composition of our PCBs in the same device, allows :

- to mix these optics to differentiate the zones and treat them specifically.
- to mix tones and/or color temperatures.

The possibilities thus proposed will offer the best possible adaptation to the luminous fluxes distribution on the different types of areas (square, roadway, sidewalk, track cycle path, service road).

FOR ROADS

R optic, 16 LED, 3700lm, 25W, 4m

swivel ang tit angle	= : 0,0 : 0,0					height orientat	ion :	4,0 m 0,0 *				ight los	a facto	r:
		-		1,0			-	-	1,0			5		
	\overline{V}	È	0.0 -		4,0			8,0 -			Ē	ĩ.5		
1.0	M.	r	P	16		-	- 32	1	16		Γ	11	1.0	
	"t	ト	$\overline{}$	Ŀ	t					\checkmark		1	17	
	N			8,0		8,0		-	1.0		-	1	·····	
		┣╲	²⁰ ۲	۴			ì	\sim	1	٢	ř	F		
		-		1,0	H,	H	1		7≊	~				
\vdash	1	-		+'	ŕŹ			\sim	1					
\vdash	+	+	-	-			-	-	-		-	-		-
+	-	-	-	-	-		-	-	-		-	-		-

The "R" road optic allows spacing up to $4.5 \times h$ (lighting height), for an equal lighting height to the width of the roadway: L=h.

This lens is ideal for road illumination and allows a good control of retro-illumination



U optic, 16 LED, 3700lm, 25W, 4m

svivel angle Sit angle	: 0,0 * : 0,0 *	height : 4,0 m orientation : 0,0 *	light loss factor : 1,
		10	
. 7	71740	2,0 4,0	
			1111
\Box			001/
	N X V		XXV
	V 20 F		120
	10		1,0
		0	

The urban "U" optics optics allows the illumination of wider roads with lower lighting height than the roadt width. Recommended spacing is $4,5 \times h$ for a carriageway width of 1,5xh.

This optics makes it possible to reduce the lighting height allowing in the meantime a satisfactory backlighting control.



FOR SPECIFICAL APPLICATIONS

(P and PCY optics are only available for high power LEDs) —

PCY optics, 16 LED, 3700lm, 25W, 4m

seivel angle Sit angle	: 0,0" : 0,0"	height : 4,0 m orientation : 0,0 *	light loss factor : 1,0
	1	2.0 1.0	
1.0	20 - 40-	40 - 40 -	\Rightarrow
	11877	22 16	
	K FW		
H		1,0 20	

The «PCY» Cycle Paths optics allows spacing up to $5 \times h$ (lighting height), for a recommended light slightly less than the width of the roadway: L<h.

D. This optics is ideal for narrow streets and lanes illumination, allowing a satisfactory **backlighting control** thanks to its light screen.



P optics, 16 LED, 3700lm, 25W, 4m

selvel angle : tit angle :	0,0 "	height : 4,0 m orientation : 0,0 *	light loss factor :
		-10-	
		TIN	Y V
	1 / /		
		+	20/
			//
			v ²
\mapsto			++++
\square			++++

The «P» Place optic allows spacing up to $3.5 \times H$ (fire height), the illuminated width is equal to $2 \times H$ (H = fire height).

This optics is ideal for squares and car parks illumination, allowing a satisfactory **backlighting control** thanks to its light screen.



SELECTION OF DRIVERS AND DIFFERENTIATED PILOTING

In this process of biodiversity preservation, to adapt to the different configurations of areas as much as night uses, it is essential to be able to pilot in different ways:

- Illuminating devices
- Drivers and LED blocks

It is therefore possible for us:

> To independently modify each colour or colour temperature according to the different nocturnal temporalities.

Example: switching from a 3000K white light at the beginning of the night, more pleasant for humans, to a much warmer (2200K for example) or coloured light, more respectful of animal species in the second half of the night.

This switch can be done using simple programming or with a remote control (using a DALI protocol).

> To modify the time slots according to seasonality

The modification of the operating ranges must be done with a remote control.

> To turn on or off upon the detection of users presence

Example: lighting in red colour to minimize the impact on bats and switching to 2200K on detection of a user with a train of lights to follow him in their his wandering.

> To offer timed interactive lighting via push buttons, or in the near future through mobile phone applications.

> To offer a forced switching on to technical services by a local control or remotely (following a DALI protocol).



SUPPORTS SELECTION

Lighting devices, alone or in groups, can be fixed on poles or in consoles on front walls according to the needs.

The choice of lighting heights must also be made according to the preservation of animal species.







CHRYSALIS

Chrysalis is a young company born in 2016 with an experience capital of more than 25 years. [Resumption of an industrial factory in France, Lorraine, doomed to closure]

The activity of the site is based on 2 industrial skills:

- Lighting
- Locksmithing/metal



ENGAGEMENT ×

1. One conviction: each project, site, region has its specificities and its unique personnality

2. Technical reliability:

a secure building principle based on a rigorous selection of components.

3 Business agility:

the ability to provide a specific response to each technical or aesthetic need from a common base

4. Sustainable logic:

a. Guaranteed lifetime (optical system +100000h, L90B10 and security chain) b. Environmental footprint reduced by half vs conventional luminaire (Dimensional Product optimized as accurately as possible with a reduction in material consumption raw),

c. Over 95% local subcontracting (less than 300km)

d. Societal commitment (artistic support, committed disabled employment, parity approach)

5. Loyalty principle

It must dictate our daily actions :

a. with our customers (to whom we owe accurate and reliable answers)

b. with our partners (respecting long-term commitments)

c. with our employees (recognition of the accomplished work)

d. with our shareholders (recognition of the financial commitment both at the start and investing further).



OUR A.D.N.

1/ CUSTOM ILLUMINATION

Our project developments are focused on three aspects :

- > Human activity
- > Biodiversity and the environment.
- >The uniqueness of places.

We consider each site, project as unique, both in terms of uses and aesthetic terms.

In effect within the framework of a development in a region, a city, a village, or a district, the project necessarily emanates a unique essence. Street furniture and lighting should echo it.

To respond to this diversity, we have essentially developed a concept based on :

• The Lolita: an industrialized lighting unit that is nevertheless modular in its equipment (optics, PCB, led and biodiv system).

• Dressings around this concept to give the object different styles.

This base gives us the necessary agility to adapt to each project.



We leave everyone free to act on:

> the objects with an extended colour chart

The finesse of our Luminaire and its kit design make possible to add colorful minimalist touches to the environment.



> the style with different dressings:



> **tailor-made development** to meet more specific or advanced project needs.



2/ RE-EMPLOYMENT

This optical unit and its various equipments constitute the basis of our retrofit module capable of occupying all existing luminaires.

As a result, we are working on the enhancement of the existing luminaires in reenabling and updating equipments to current uses.

This orientation is part of a broader approach linked with sustainable development, still under construction, that we will not fail to develop in a later phase.



Before and after a luminaire retrofit, city of Montauban.

BIBLIOGRAPHY LIGHT POLLUTION & BIODIVERSITY

BOOKS

Narboni R. et Guerard F., Les défis de l'éclairage public - Contexte, acteurs, stratégies et outils, Territorial éditions, Voiron, 2021.

Sordello R., Paquier F. et Daloz A. Trame noire, méthodologie d'élaboration et outils pour sa mise en œuvre, Office français de la biodiversité, Collection Comprendre pour agir, 2021.

Sordello R. Pollution lumineuse : longueurs d'ondes impactantes pour la biodiversité, Exploitation de la synthèse bibliographique de Musters et al. (2009), Rapport Patrinat n°2017-117, décembre 2017.

MEB et ANPCEN Éclairage du 21^e siècle et biodiversité, pour une meilleure prise en compte des externalités de l'éclairage extérieur sur notre environnement, Les cahiers Biodiv'2050, CDC biodiversité, N°6 juillet 2015.

Zielinska-Dabkowska K. M., Michael F. Rohde Ouvrage collectif, New Perspectives on the Future of Healthy Light and Lighting in Daily Life, publisher callidus, editor.

ARTICLES

ASAP. (2022). The Alarming Effects of Light Pollution on Trees and What You Can Do To Help. Amazon Services LLC Associates Program.

Baker B. J. (2006). The effect of artificial light on male breeding-season behaviour in green frogs, Rana clamitans malanota. Department of Biological Sciences. University St. Catharines. Canada.Vol. 36.

Bouroussis A. K. (2021). Ecological Impact of Artificial Light at Night.

Challéat S. (2009). La pollution lumineuse : passer de la définition d'un problème à sa prise en compte technique. Eclairer la ville autrement - Innovations et expérimentations en éclairage public. Presses Polytechniques Universitaires Romandes.

Dominoni, D. M. (2013). Urban-like night illumination reduces melatonin release in European blackbirds (Turdus merula): implications of city life for biological time-keeping of songbirds.

EE. (nd). *Impact of light pollution on aquatic organisms*. Retrieved from Enceclopedia of the environment: https://www.encyclopedie-environnement.org/en/zoom/impact-of-light-pollution-on-aquatic-organisms/

Gauthreaux, C. G. (2006). Effects of Artificial Night Lighting on Migrating Birds. USDA. Bibliography.

IGB. (2018). *Light pollution a reason for insect decline*? Retrieved from IGB: https://www.igb-berlin.de/en/news/light-pollution-reason-insect-decline

Longcore, T. (2004). *Ecological light pollution*. Frontiers in Ecology and the Environment. Martin, A. a.

Naraharisetty, R. (2021). *Light Pollution from Street Lights Could Drive Insect Loss: Study.* Retrieved from The Swaddle: https://theswaddle.com/insect-loss-linked-light-pollution/

Sordello R. (2017). *Pollution lumineuse et trame verte et bleue : vers une trame noire en France ?* Territory in movement Journal of geography and planning. Université Lille I Sciences et Technologies. https://doi.org/10.4000/tem.4381





168 rue de la fonderie Z.I Pompey Industrie 54670 CUSTINES France • Tel: +33 (0)3 83 49 63 63 • Mail: contact@chrysaliseclairage.com www.chrysaliseclairage.com