EUROPEAN UNION
European Structural and Investment Funds
Operational Programme Research,
Development and Education

MINISTRY OF EDUCATION, YOUTH AND SPORTS

Light pollution – what do we know about its impacts

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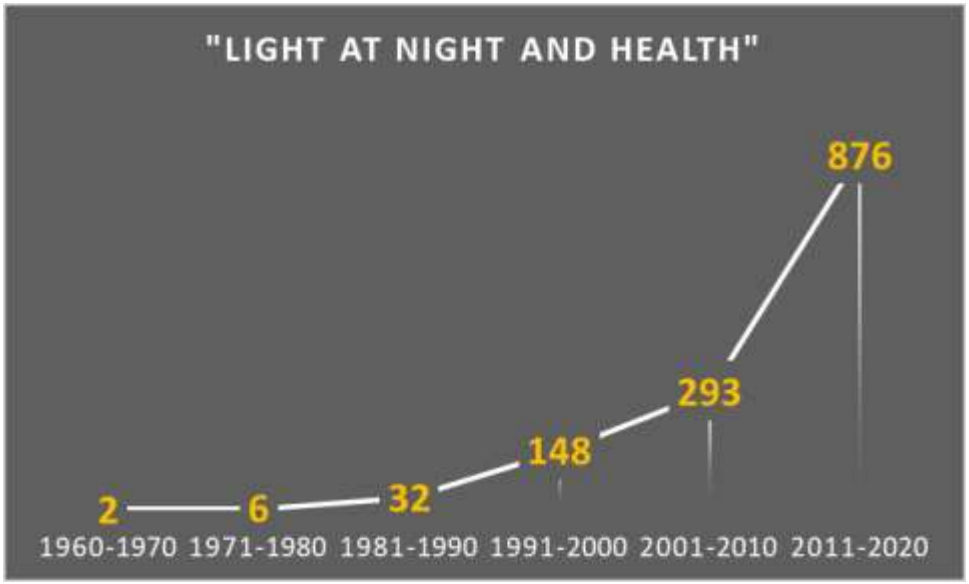
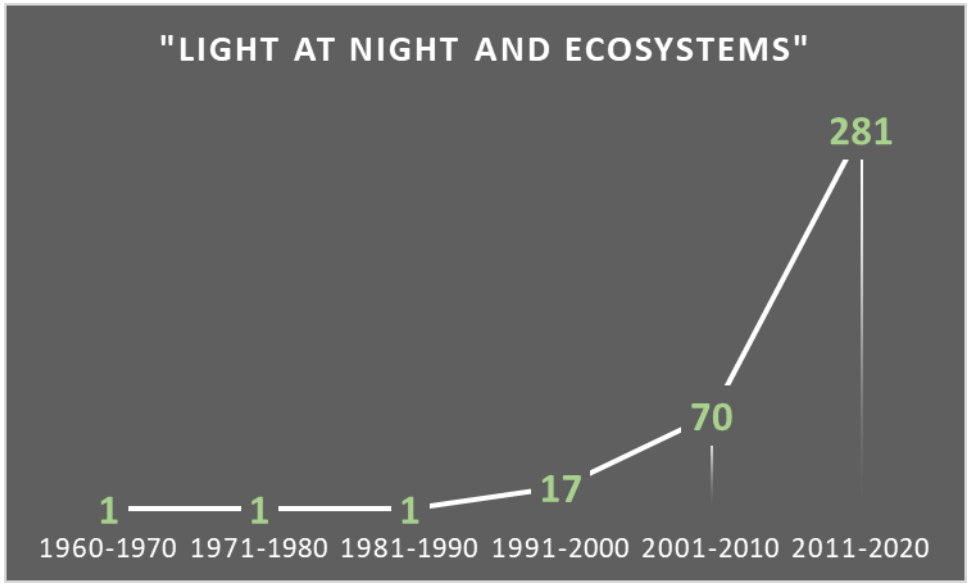
Workshop on light pollution, 14.5. 2020
Under the auspices of the Czech V4 presidency

Number of publications in the biomedical database PubMed searched by keywords „light at night AND health“ to 13.5. 2020

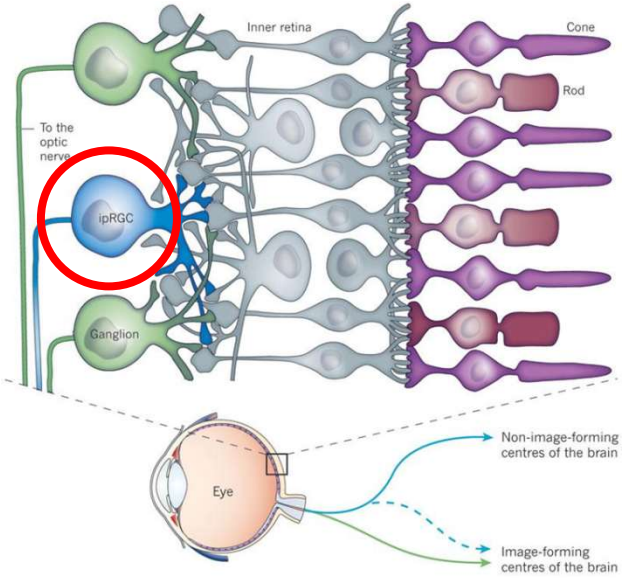


Number of publications in the biomedical database PubMed searched by keywords „light at night AND ecosystem“ to 13.5. 2020



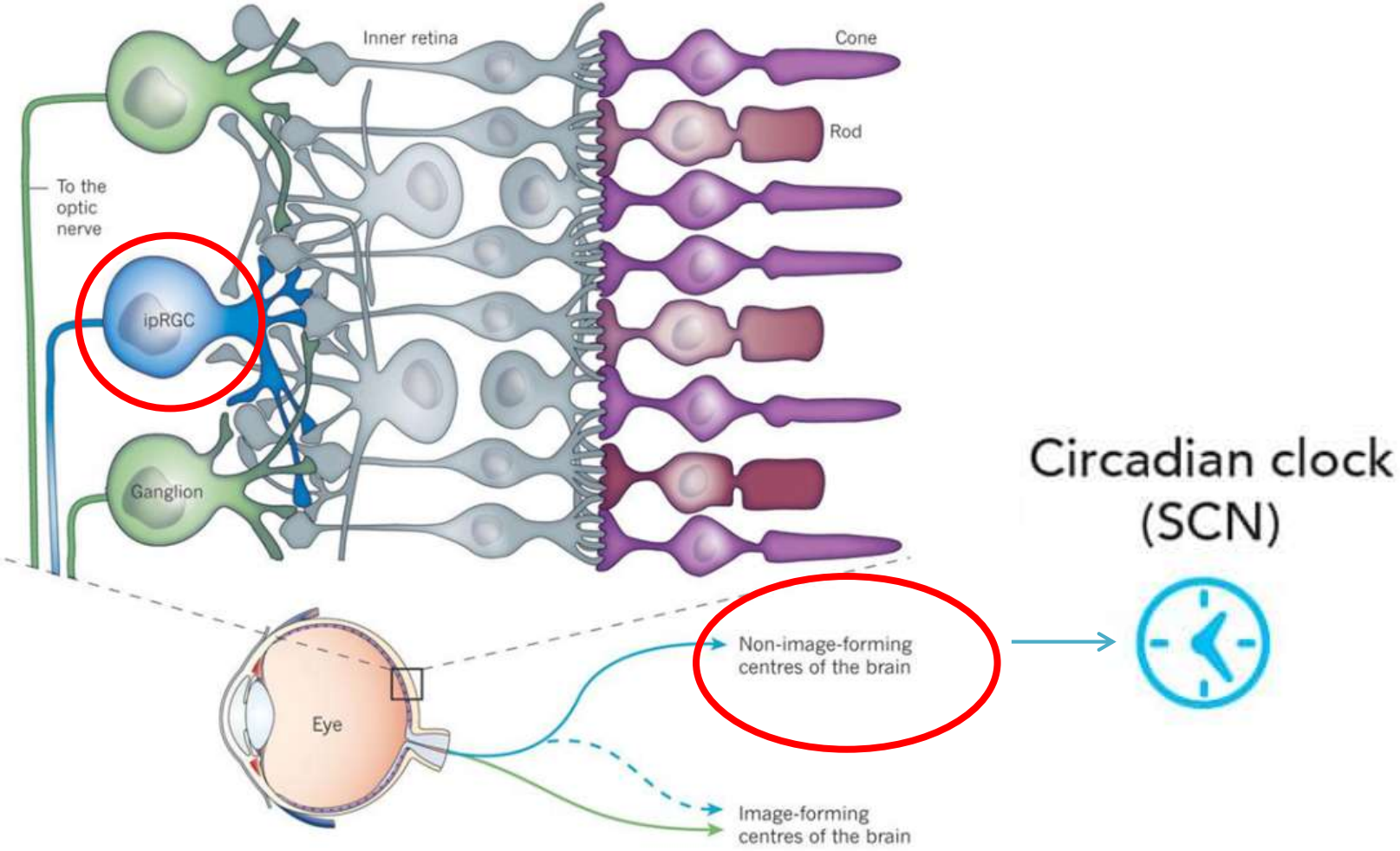
..around the year 2000...

1) the expansion of LED lightings in the public environment



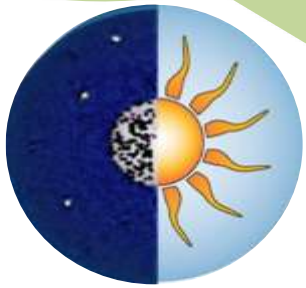
2) the discovery of intrinsically photoresponsive retinal ganglion cells with melanopsin in the retina

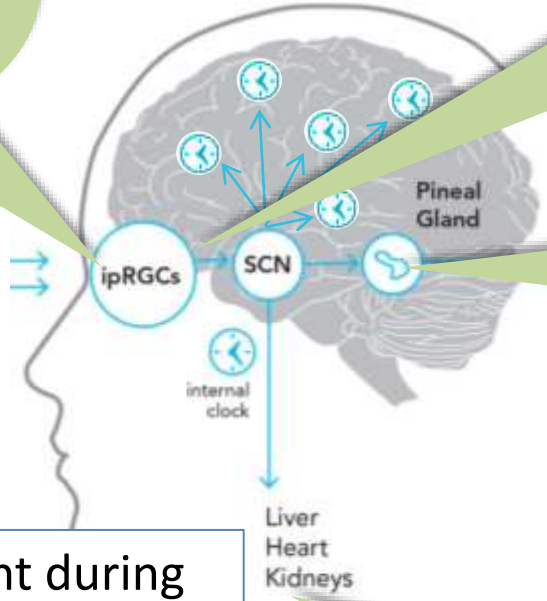
ipRGC with melanopsin in the retina



The circadian clock

The circadian clock requires perpetual resetting by light/dark cycle





Major circadian clock in the SCN generates rhythms and drives the peripheral clocks in the body

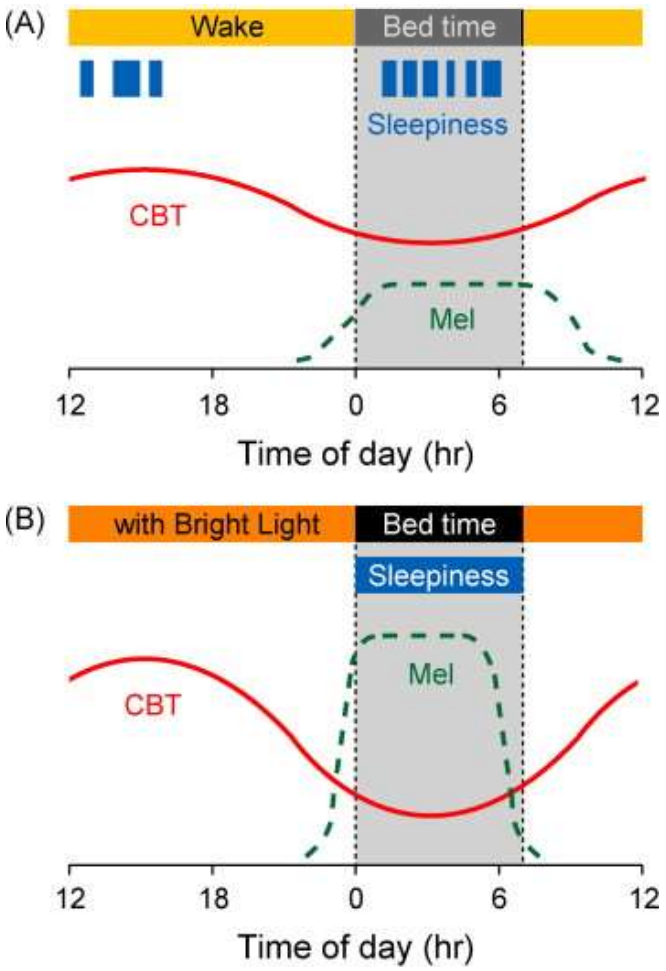
Pineal gland produces melatonin only at night and only in darkness

It is the contrast between light during the day and darkness at night that synchronizes

Higher the contrast - better the health

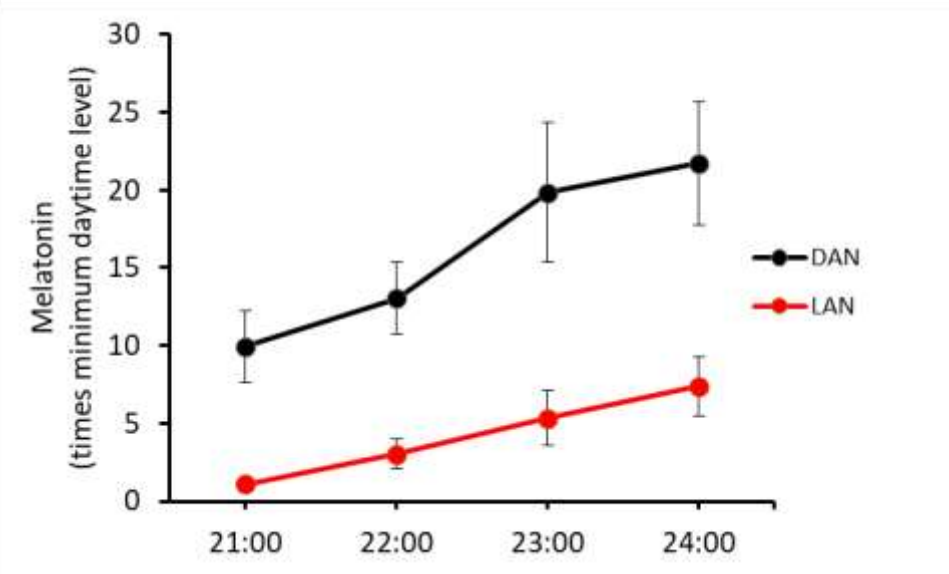
Peripheral clocks in bodily organs drive the majority of physiological processes

1) Insufficient contrast between light during the day and darkness at night reduces the amplitude of circadian rhythms



accelerated senescence

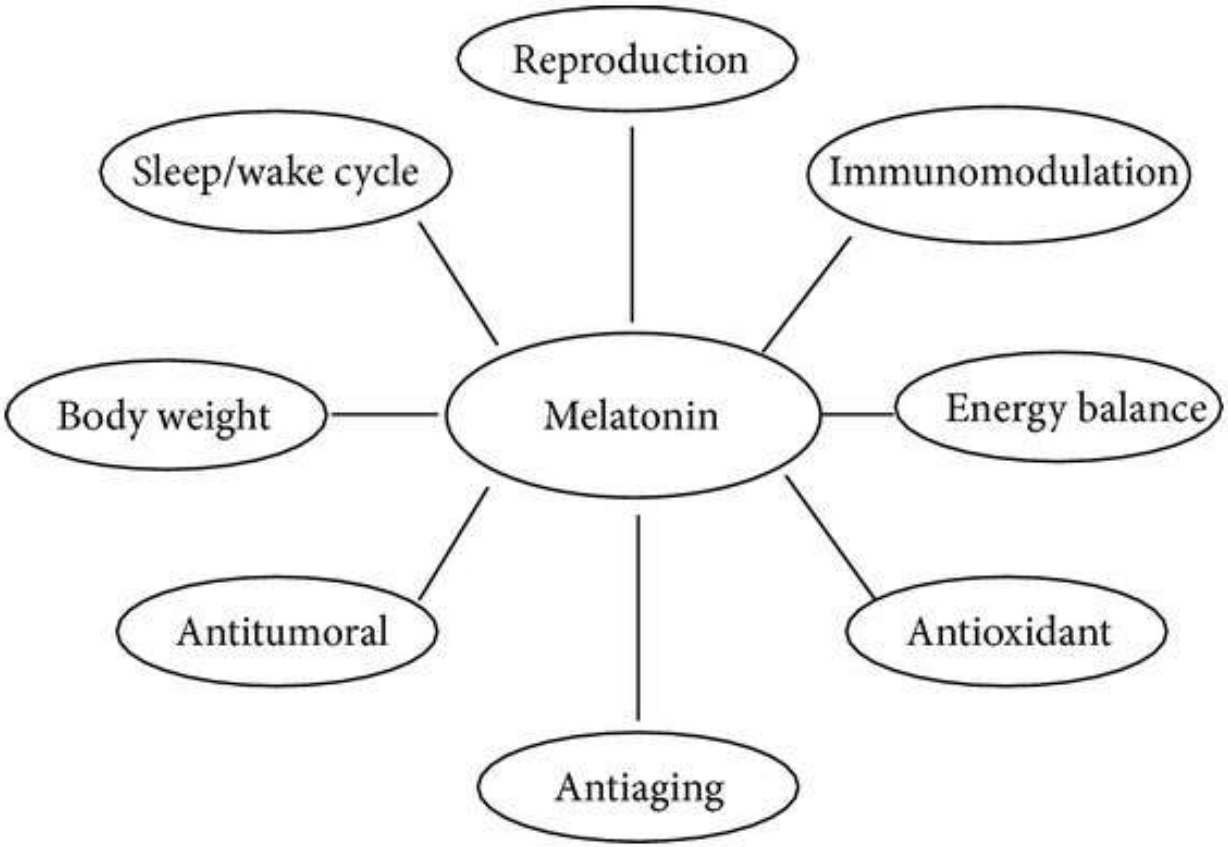
2) Light at night suppress the melatonin release

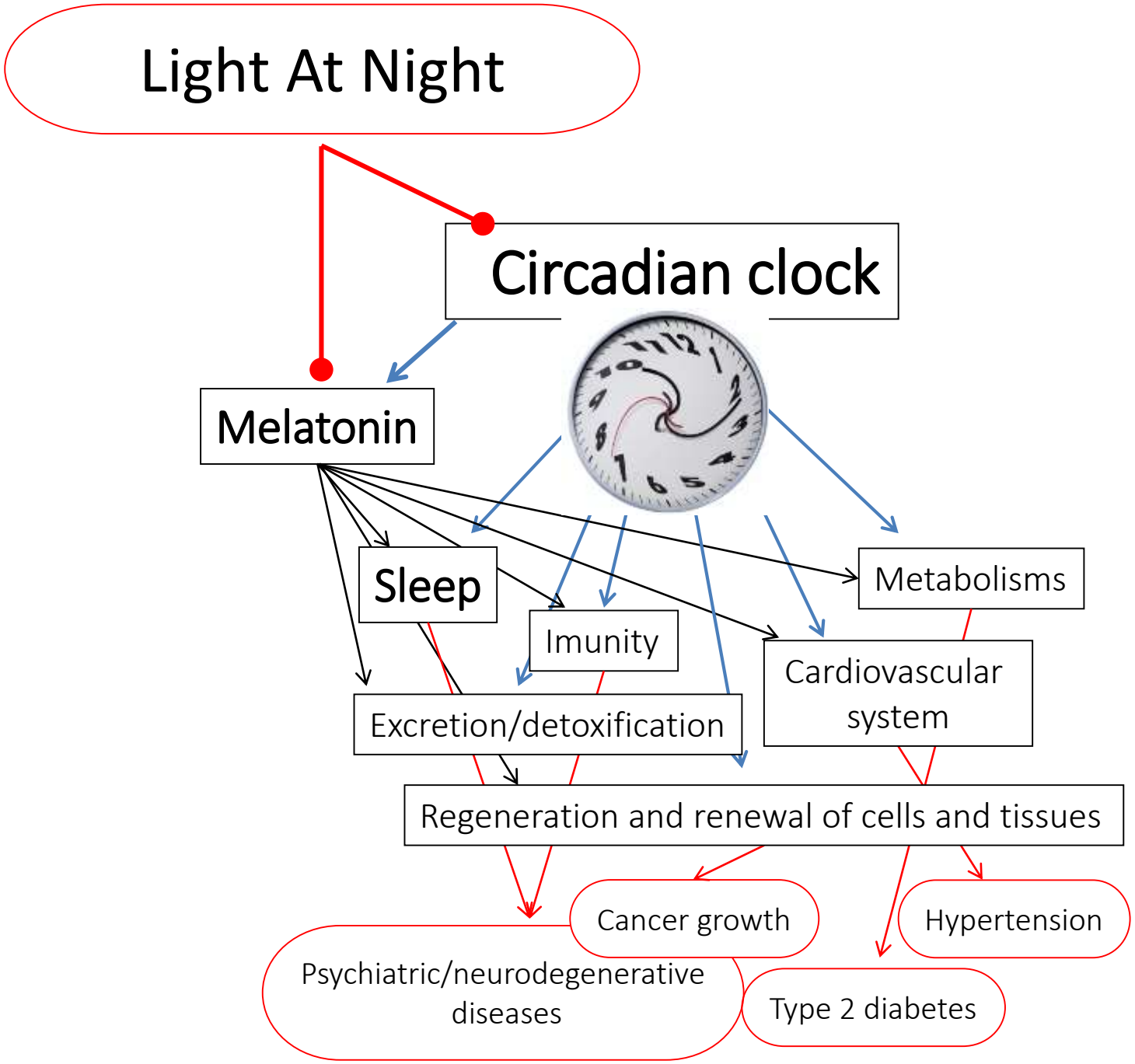


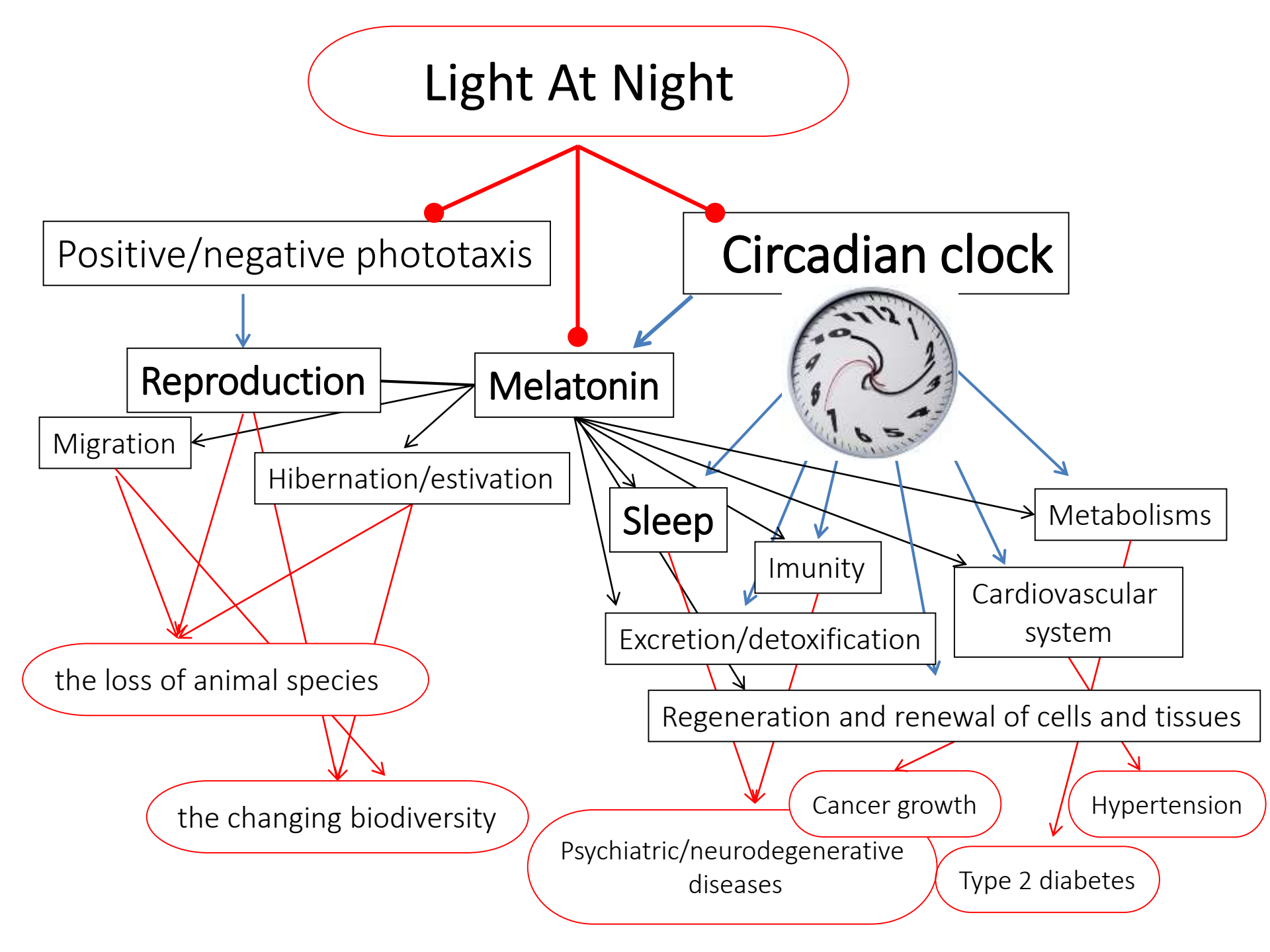
6 lux in the most sensitive individual, 350 lux in the least sensitive individual: Philips et al., 2019; https://doi.org/10.1073/pnas.1901824116

Bendová et al., (2020) unpublished results

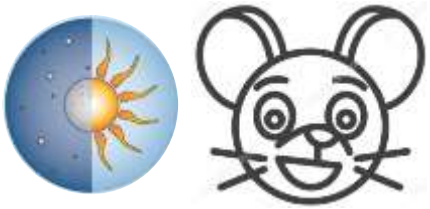
Funtions of melatonin



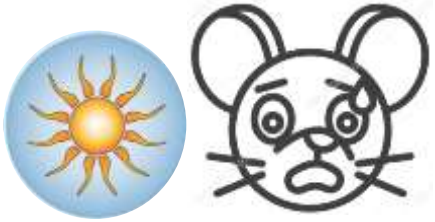

Light At Night
Circadian clock
Melatonin
Sleep
Metabolisms
Imunity
Cardiovascular system
Excretion/detoxification
Regeneration and renewal of cells and tissues
Cancer growth
Hypertension
Psychiatric/neurodegenerative diseases
Type 2 diabetes


Light At Night
Positive/negative phototaxis
Circadian clock
Reproduction
Melatonin
Migration
Hibernation/estivation
Sleep
Metabolisms
Imunity
Cardiovascular system
Excretion/detoxification
the loss of animal species
Regeneration and renewal of cells and tissues
the changing biodiversity
Cancer growth
Hypertension
Psychiatric/neurodegenerative diseases
Type 2 diabetes

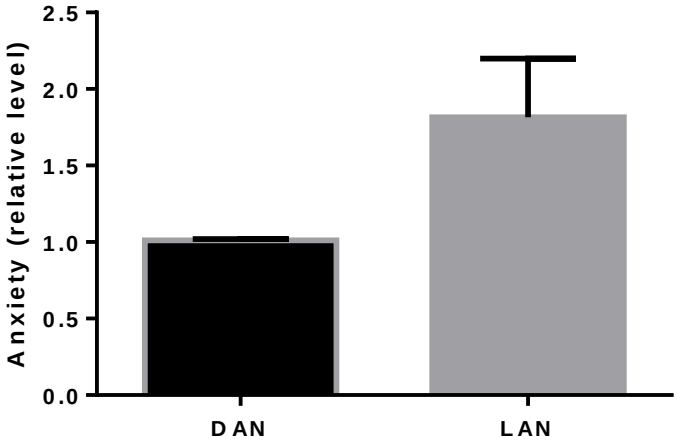
Rats that were exposed to LAN early postnatally show increased anxiety in adulthood



DAN: 12h of light:12h of darkness



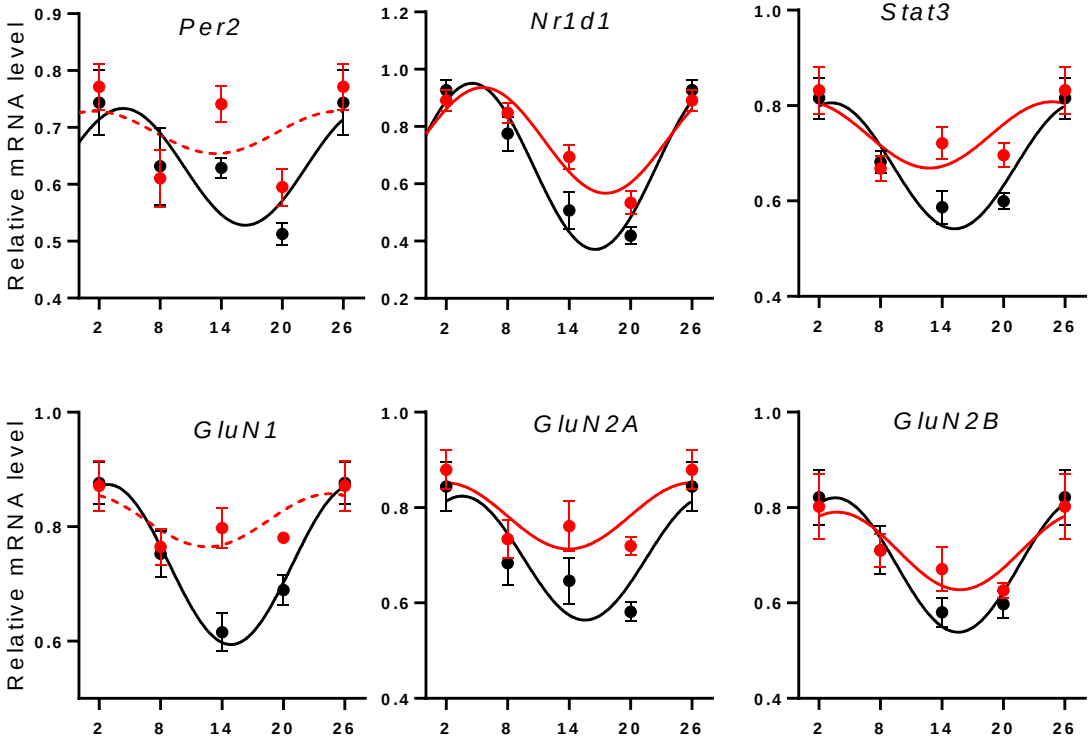
LAN: constant light (30lx) between P0-P21
DAN: 12h of light:12h of darkness from P22

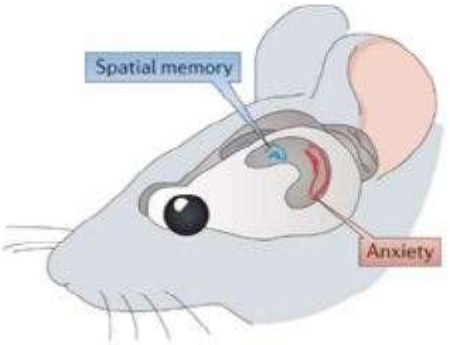


tests: at P90

Bendová et al., (2020) unpublished results (but other labs as well)

The amplitude of circadian rhythms is blunted on the level of gene expression, for example in the hippocampus - the centre of memory formation





LAN

DAN

Bendová et al., (2020) unpublished results

- Biomedical research → human centric

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solution

Ecological problem

Medical, hygienic problem

- Biomedical research → human centric
- Animal laboratory model → wildlife

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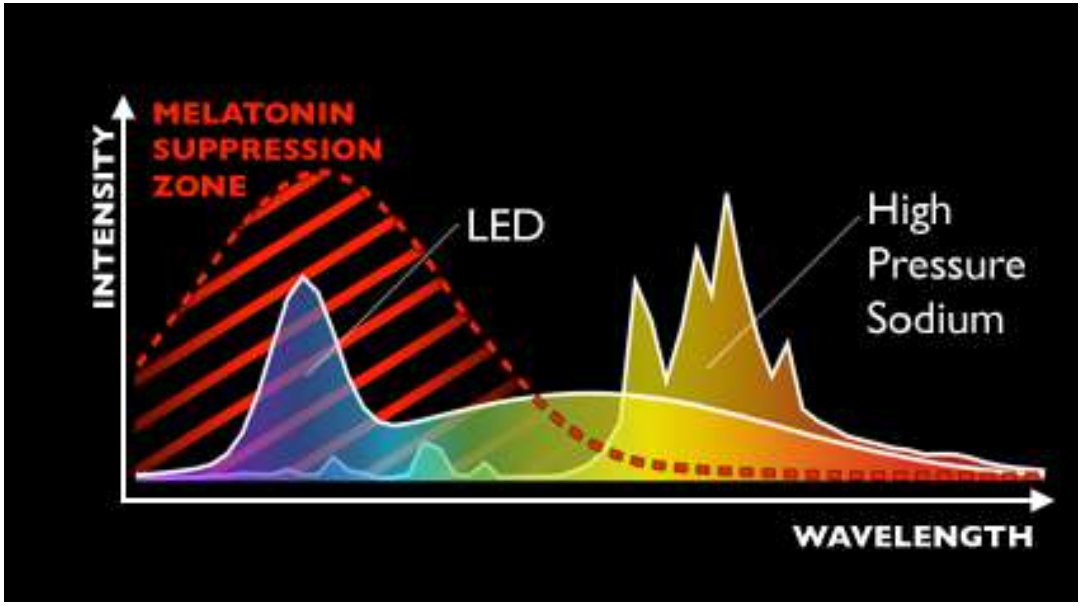
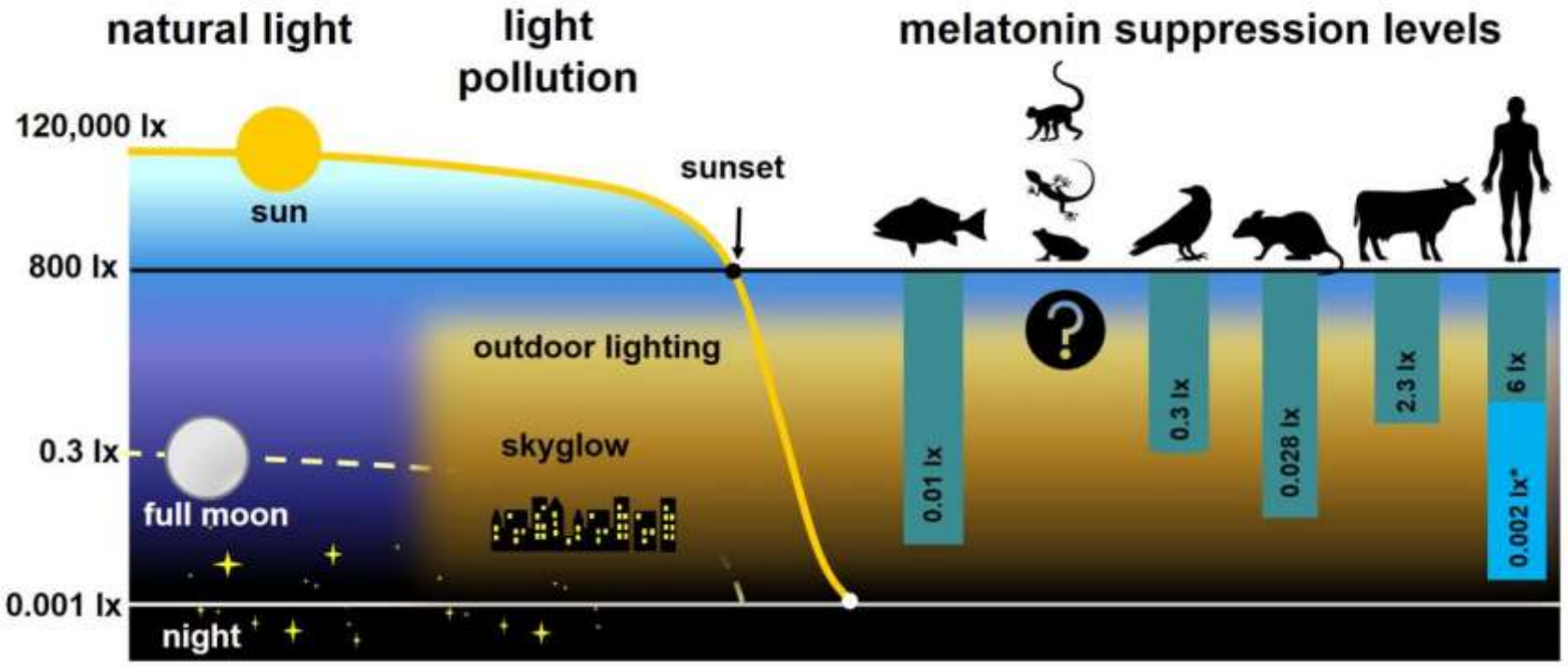
LAN-induced pathophysiological effects that we observe in the laboratory in the wild animals?

Spectrum



http://ricemm.org/en/light-pollution/multiple-impacts/

Intensity



https://www.eurekalert.org/multimedia/pub/220160.php

Thank you