SensiLum VR

Experiencing Territories Through the Eyes of Animals Under Artificial Light

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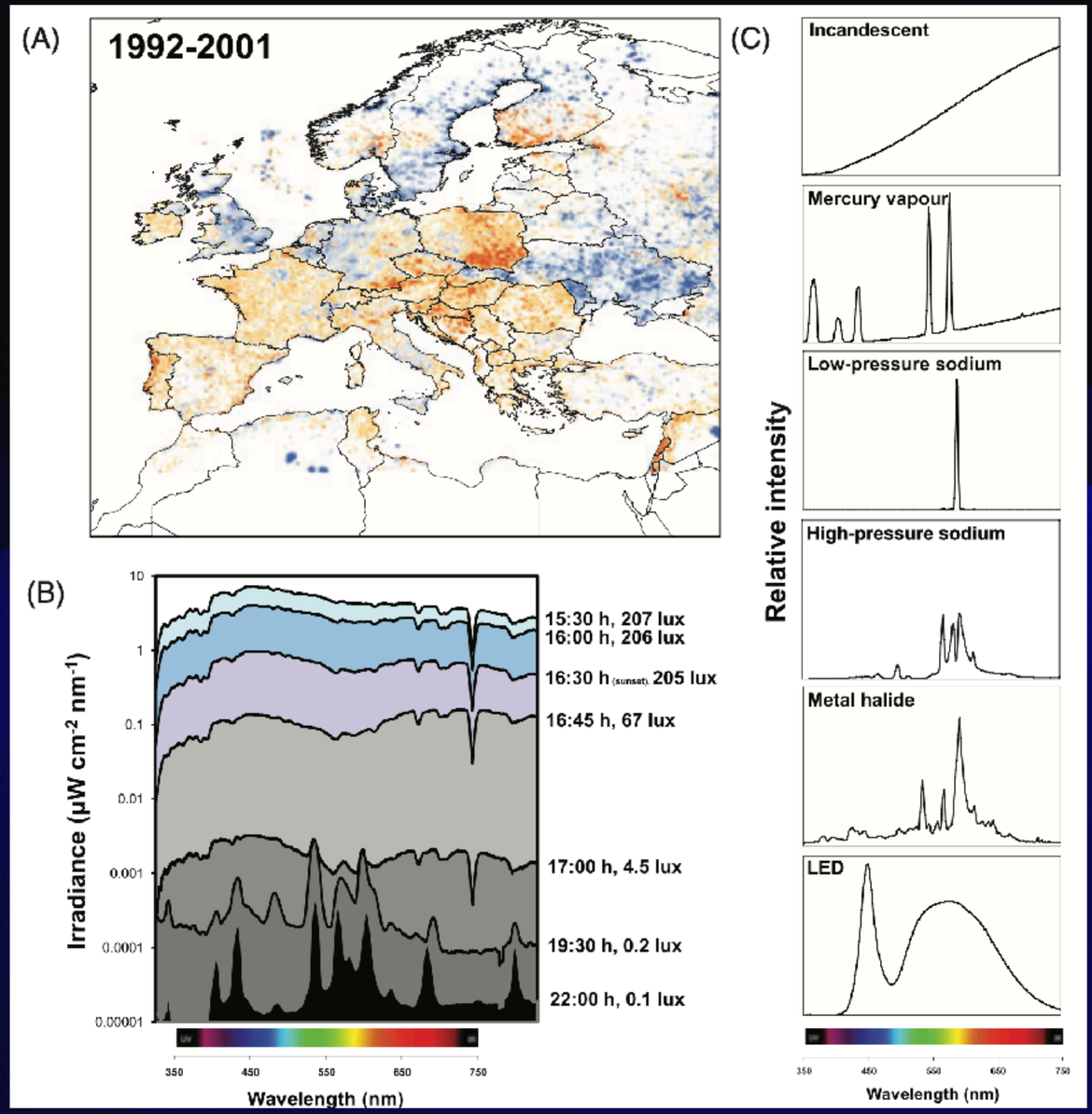
Maxim Spur, 09/10/2025
Journée Territoires et Immersion(s) — Pessac

Artificial Light at Night — ALAN

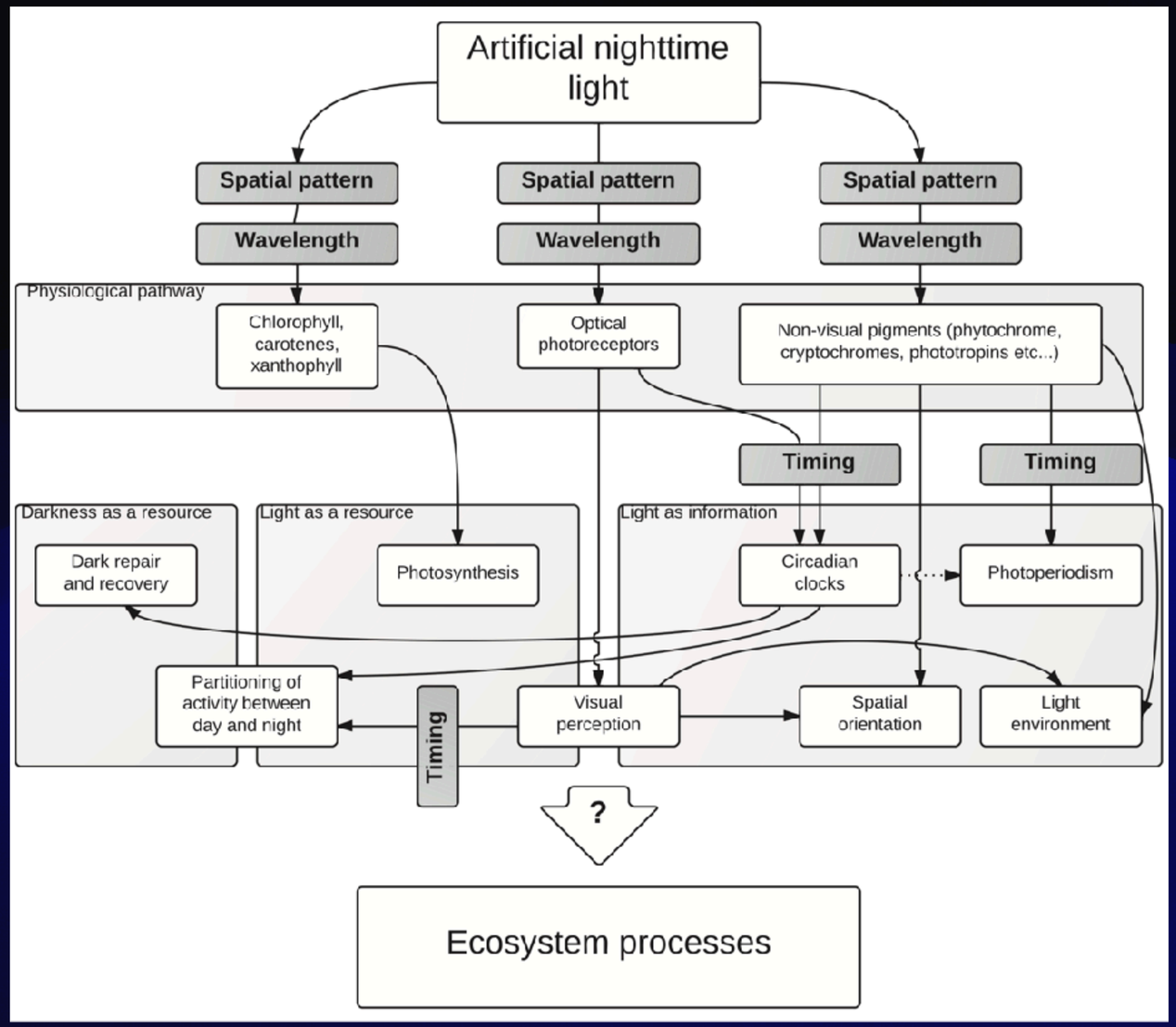
- Increase of nighttime illumination
- Introduction and change of artificial emission spectra



K. J. Gaston, J. Bennie, T. W. Davies, and J. Hopkins.
The ecological impacts of nighttime light pollution: a mechanistic appraisal. Biological reviews, 88(4):912–927, 2013.

ALAN’s effect on organisms and ecosystems

- Perception
- Orientation
- Physiology
- Reproduction
- Ecosystem
- Human life



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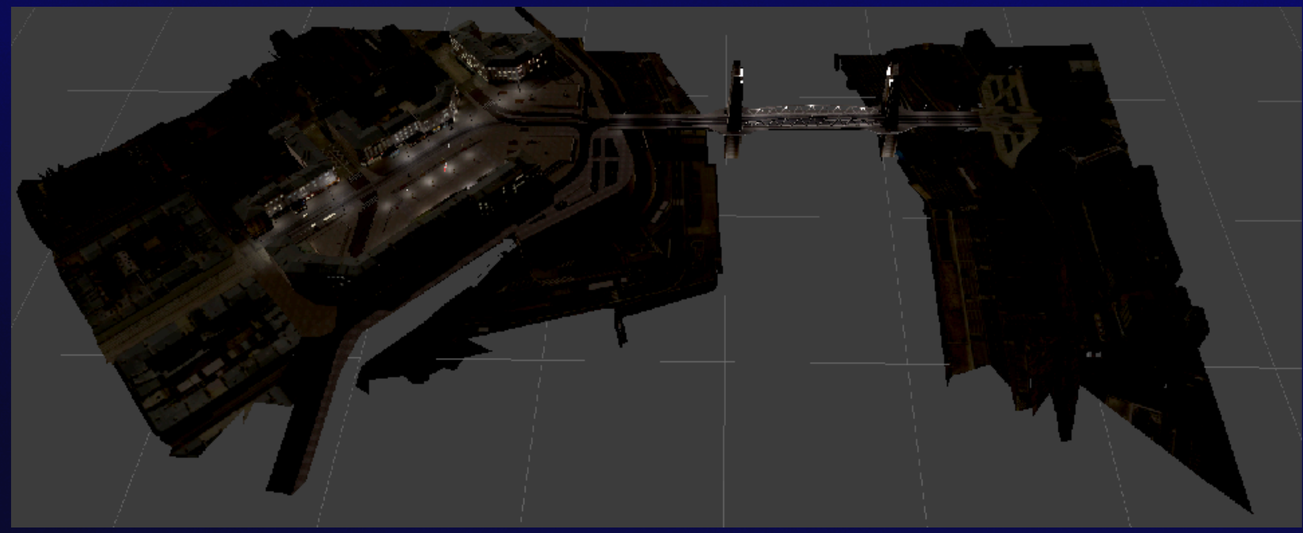
ALAN Policy

- Energy savings
- Night sky preservation
- Switch from Sodium to LED
- Cutting lights after midnight

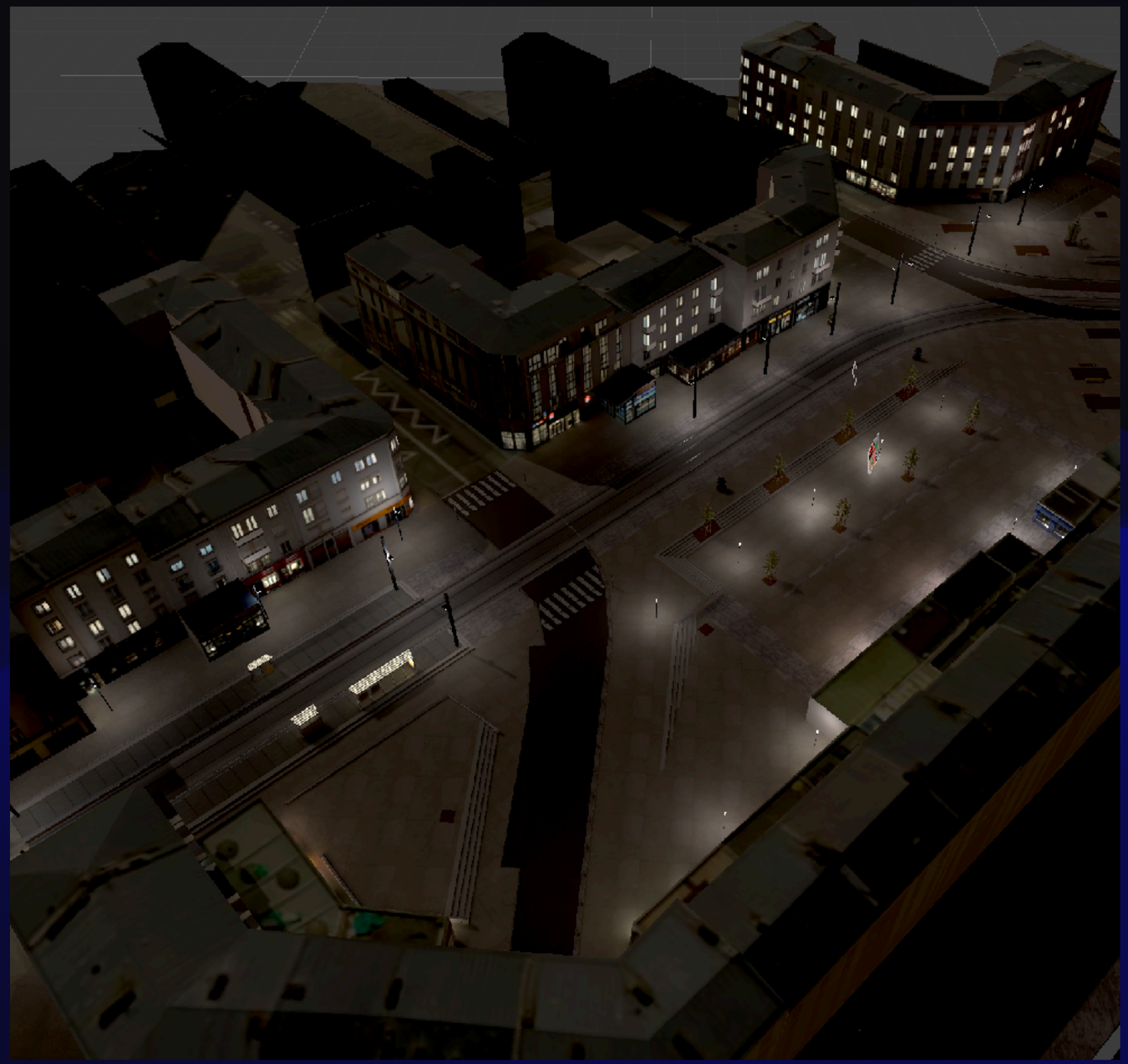
ALAN Policy Communication: Immersive Simulation

- 3D city model



ALAN Policy Communication: Immersive Simulation

- 3D city model
- Modeling ALAN scenarios



regular (current) lights

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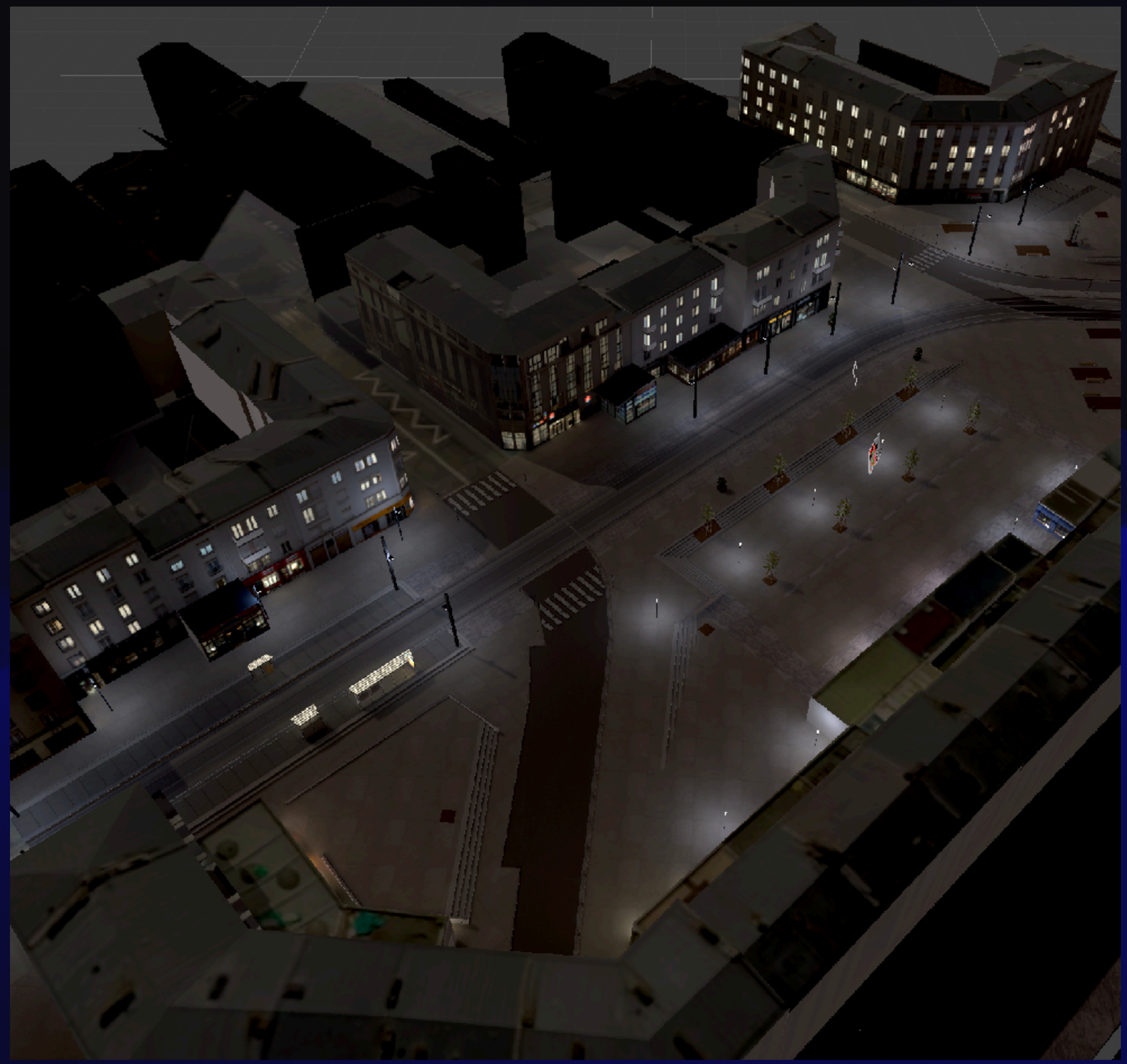

LED lights

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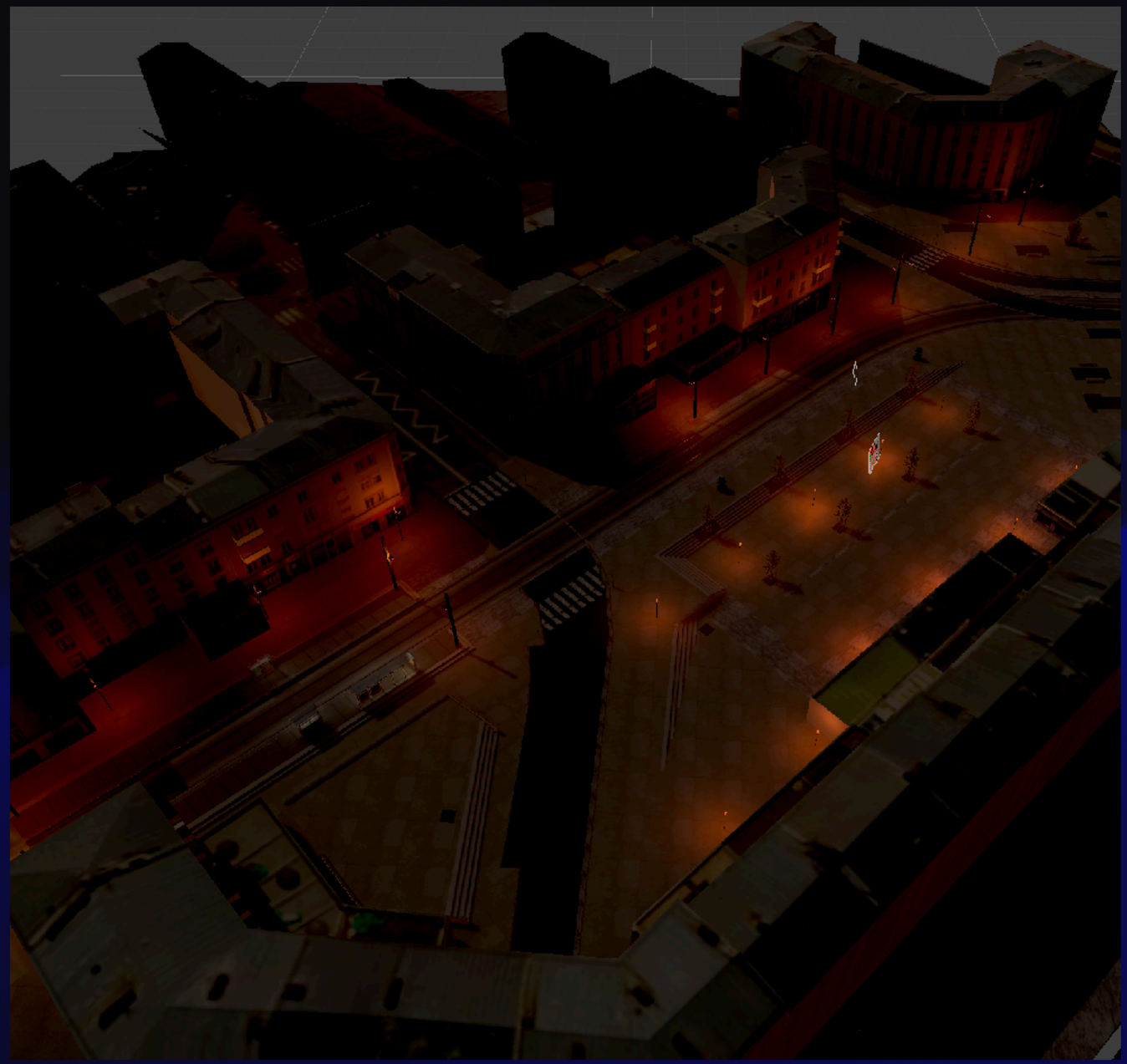

dimmed red lights

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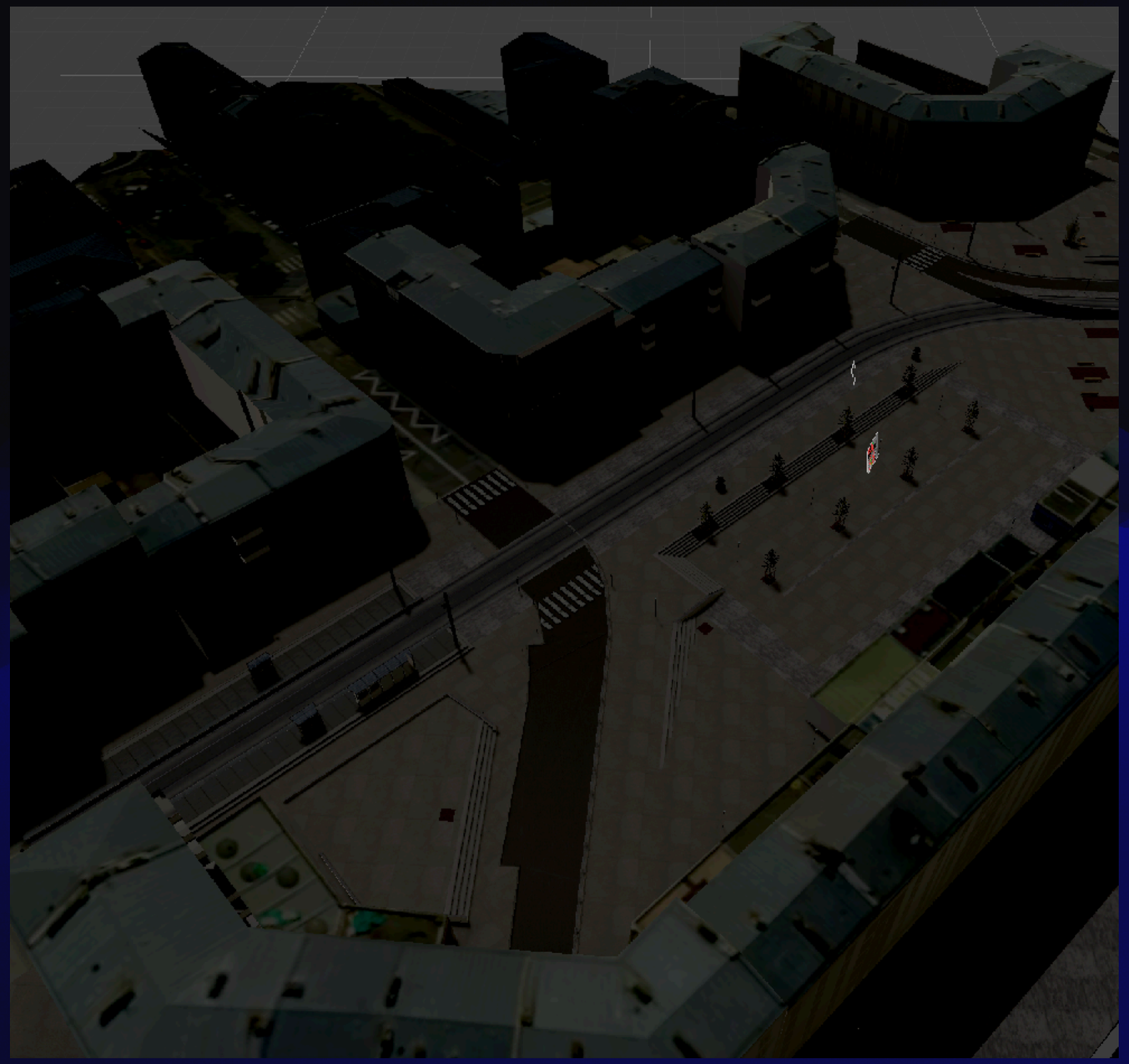

lights out (moonlight)

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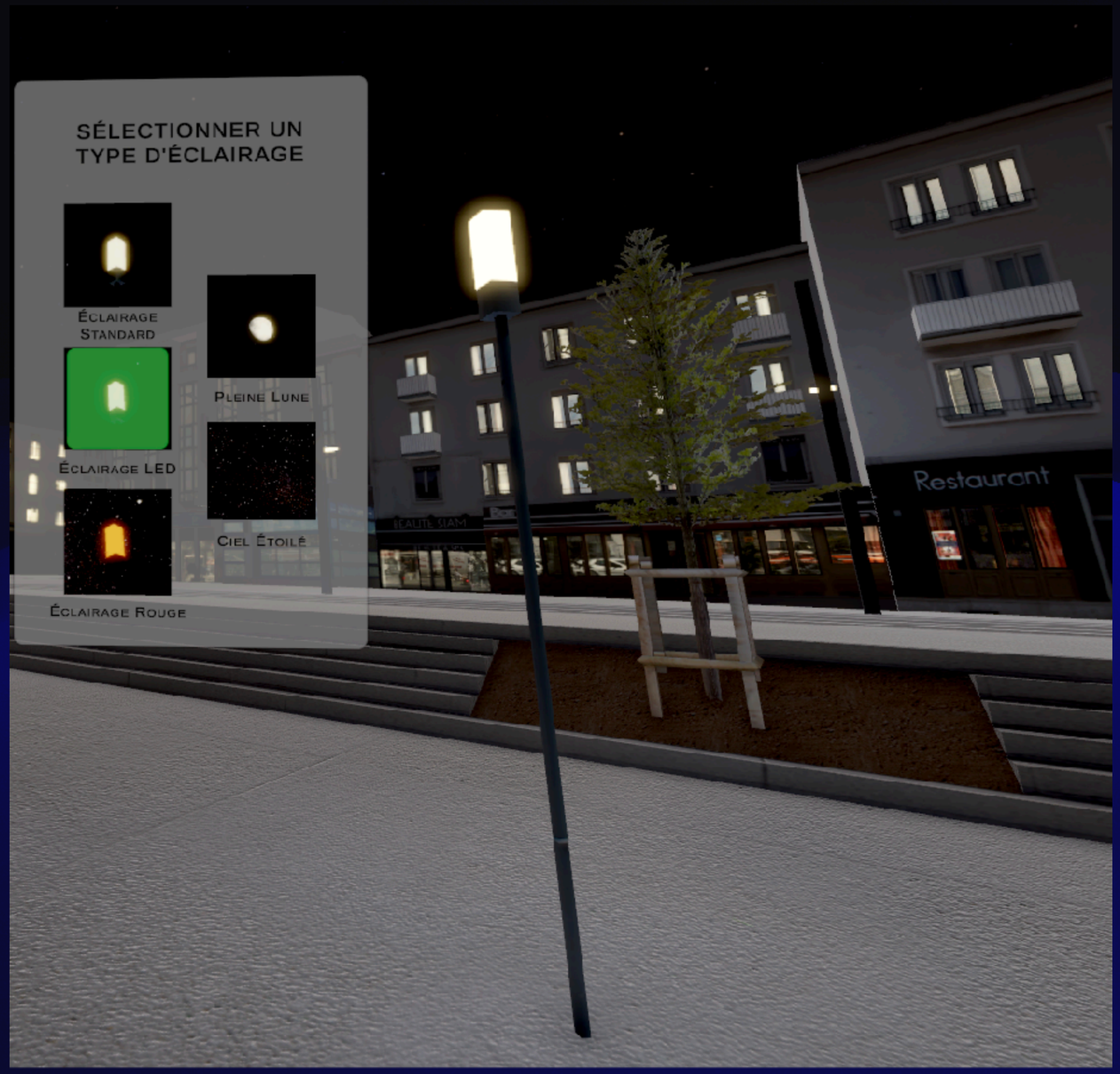
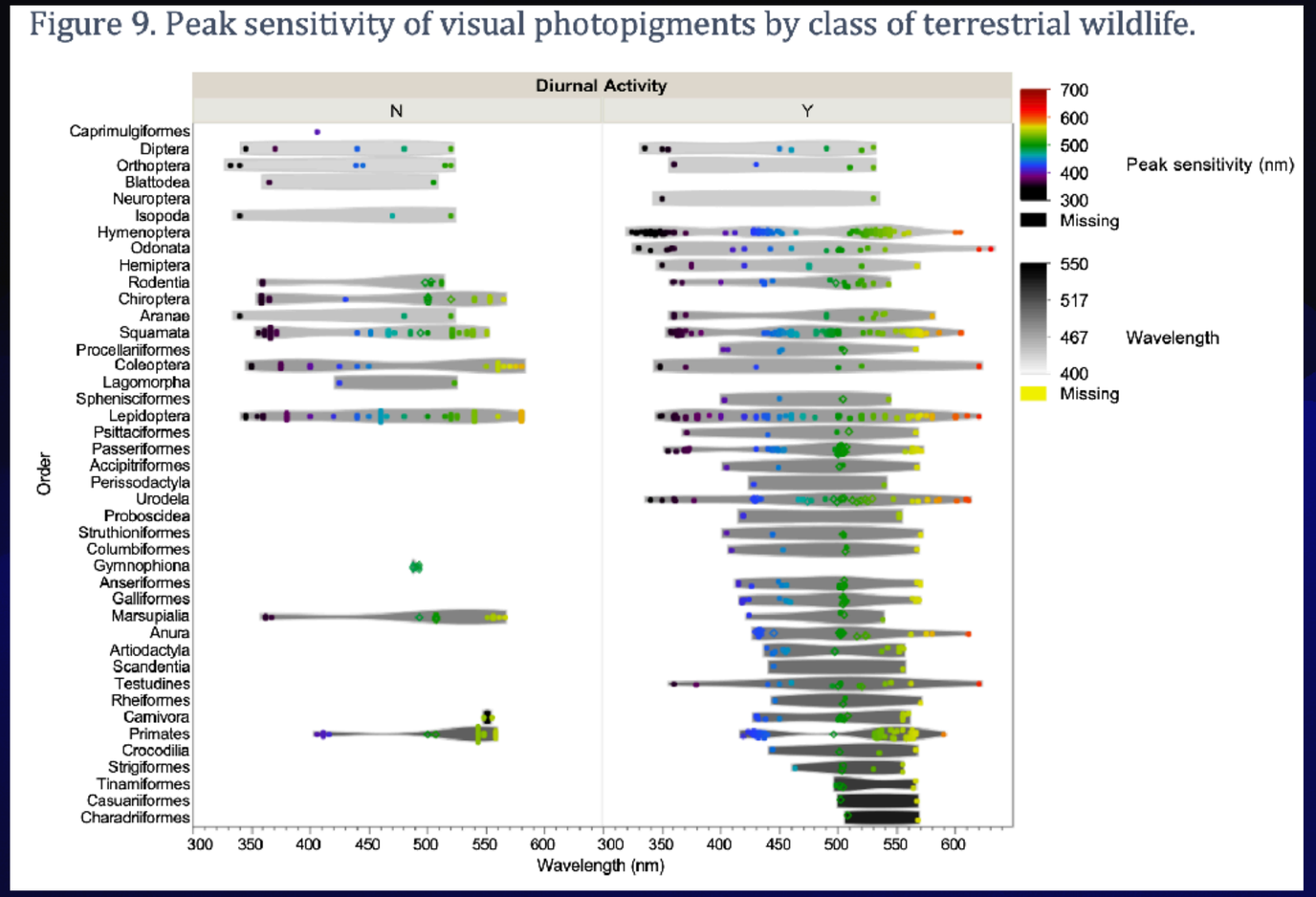
- 3D city model
- Modeling ALAN scenarios
- Explore in VR



VR view

Visualizing animal light perception

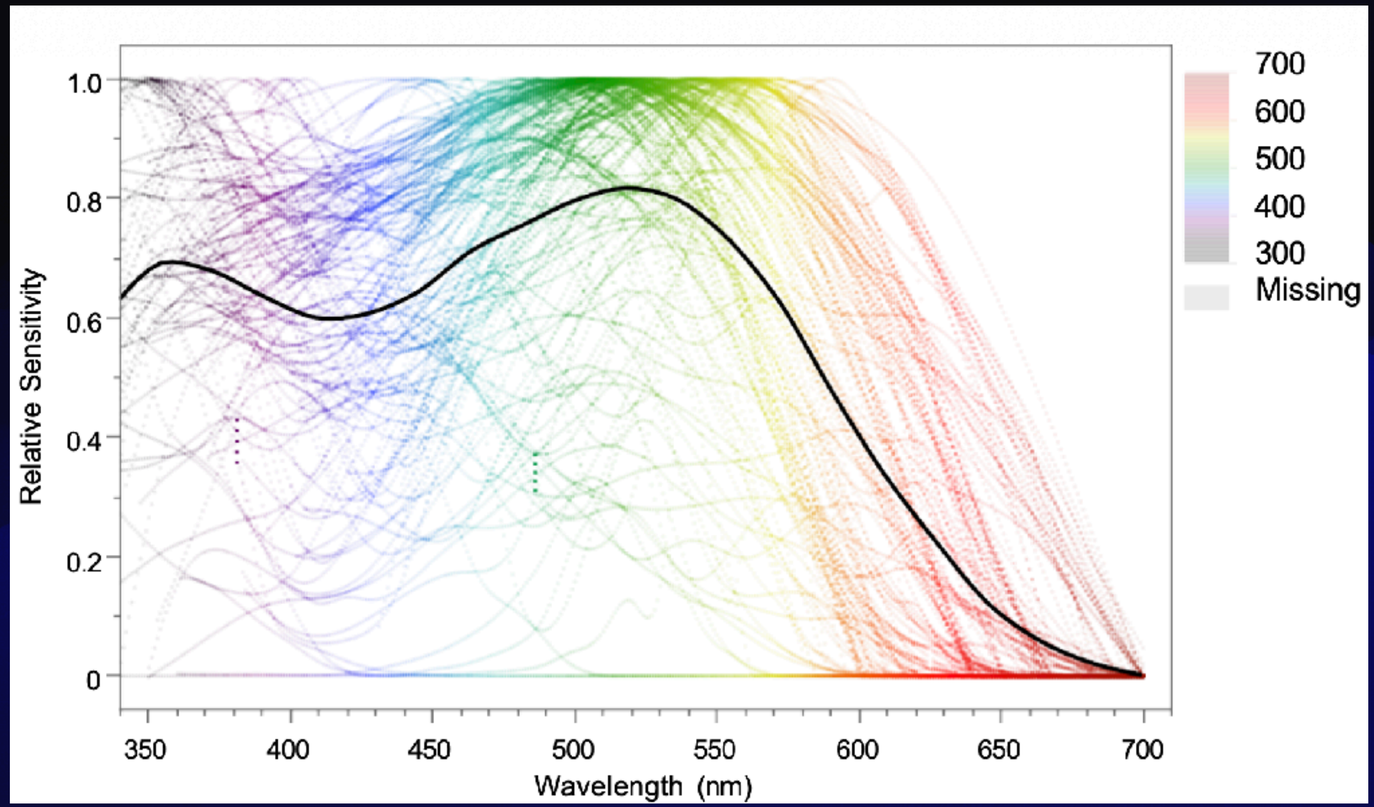
- **Measurement of visual photopigment sensitivity**



T. Longcore et al. Effects of led lighting on terrestrial wildlife

Visualizing animal light perception

- Measurement of visual photopigment sensitivity
- Derivation of spectral sensitivity



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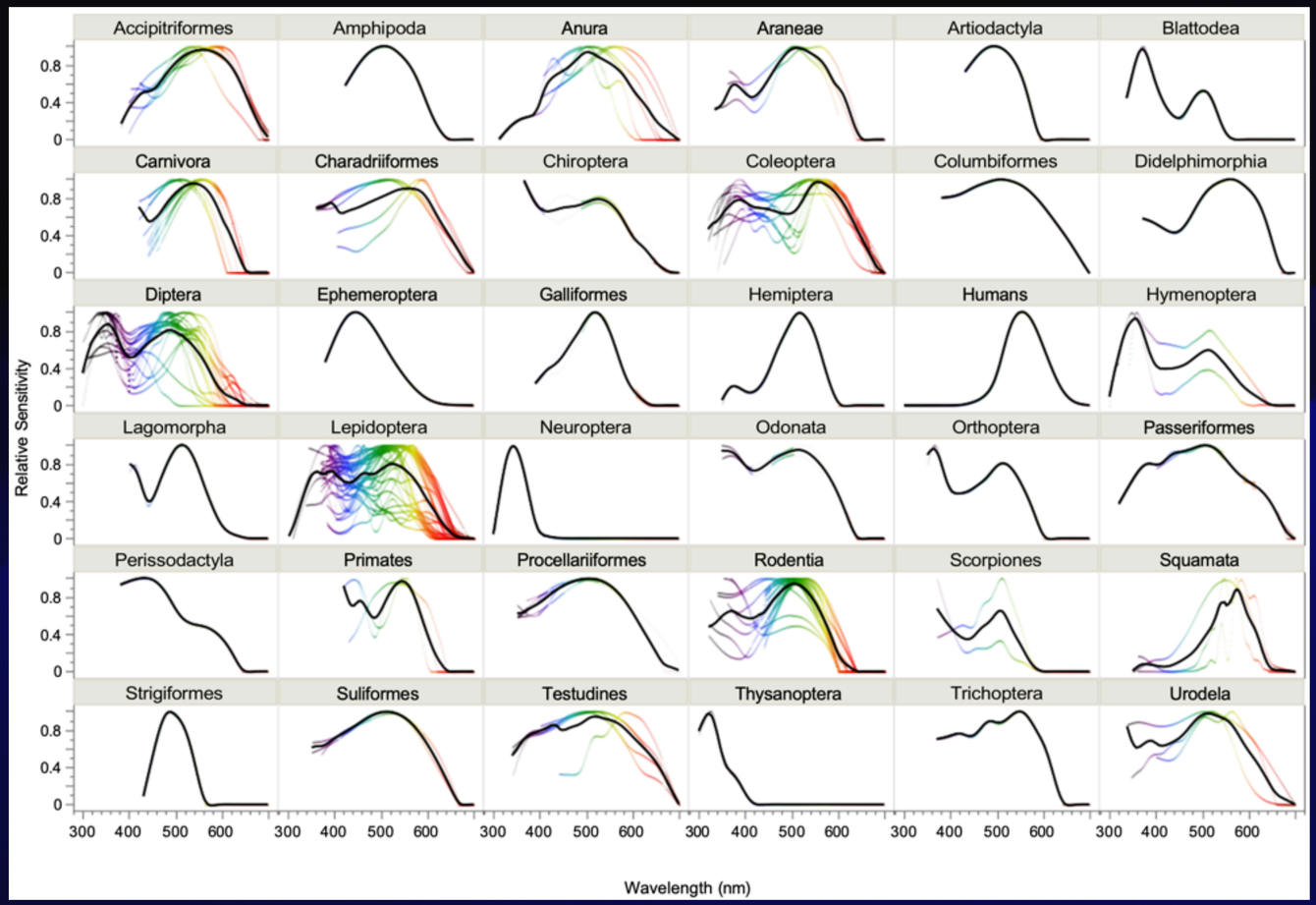

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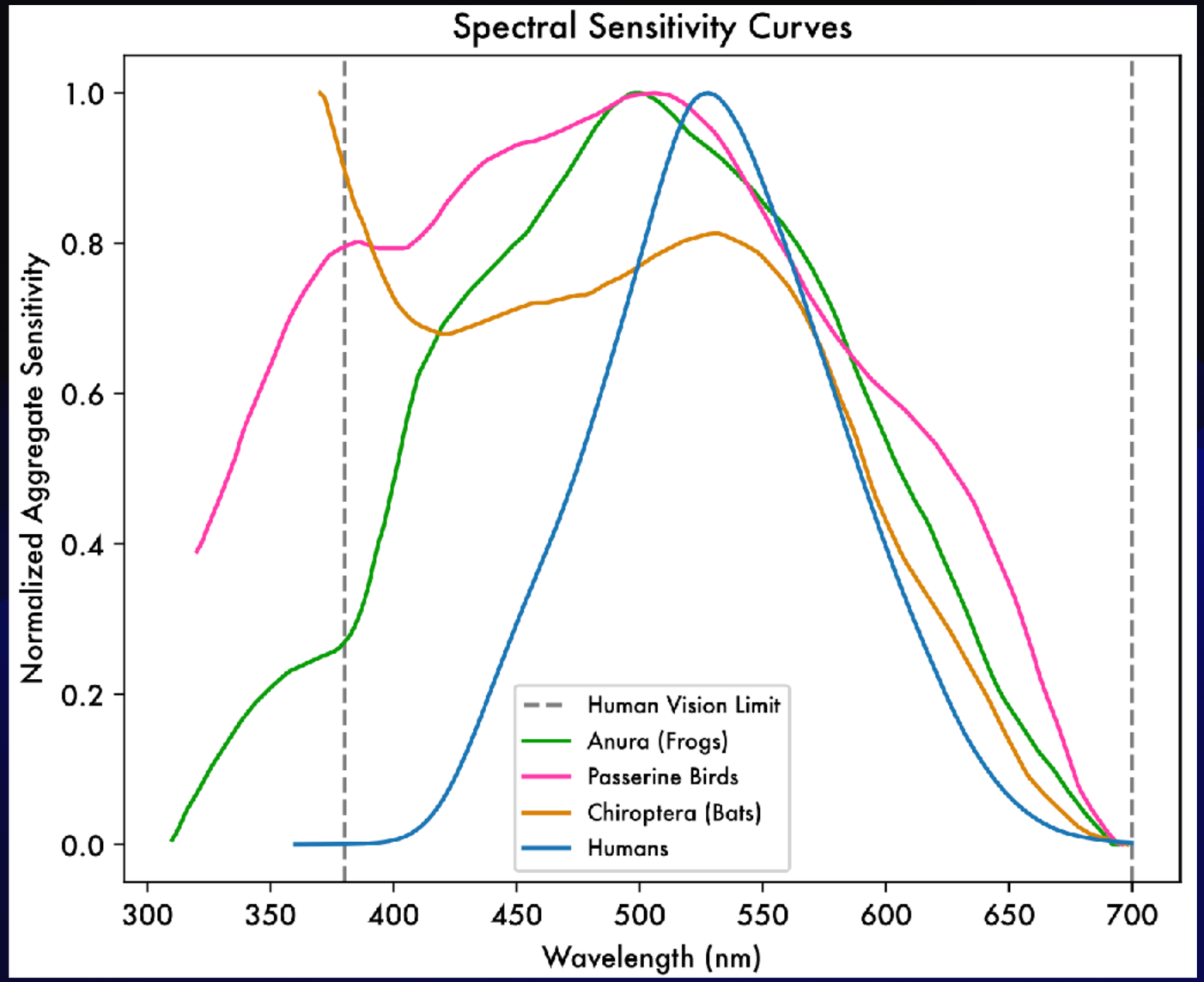
Visualizing animal light perception

- Measurement of visual photopigment sensitivity
- Derivation of spectral sensitivity
- Compared to human vision



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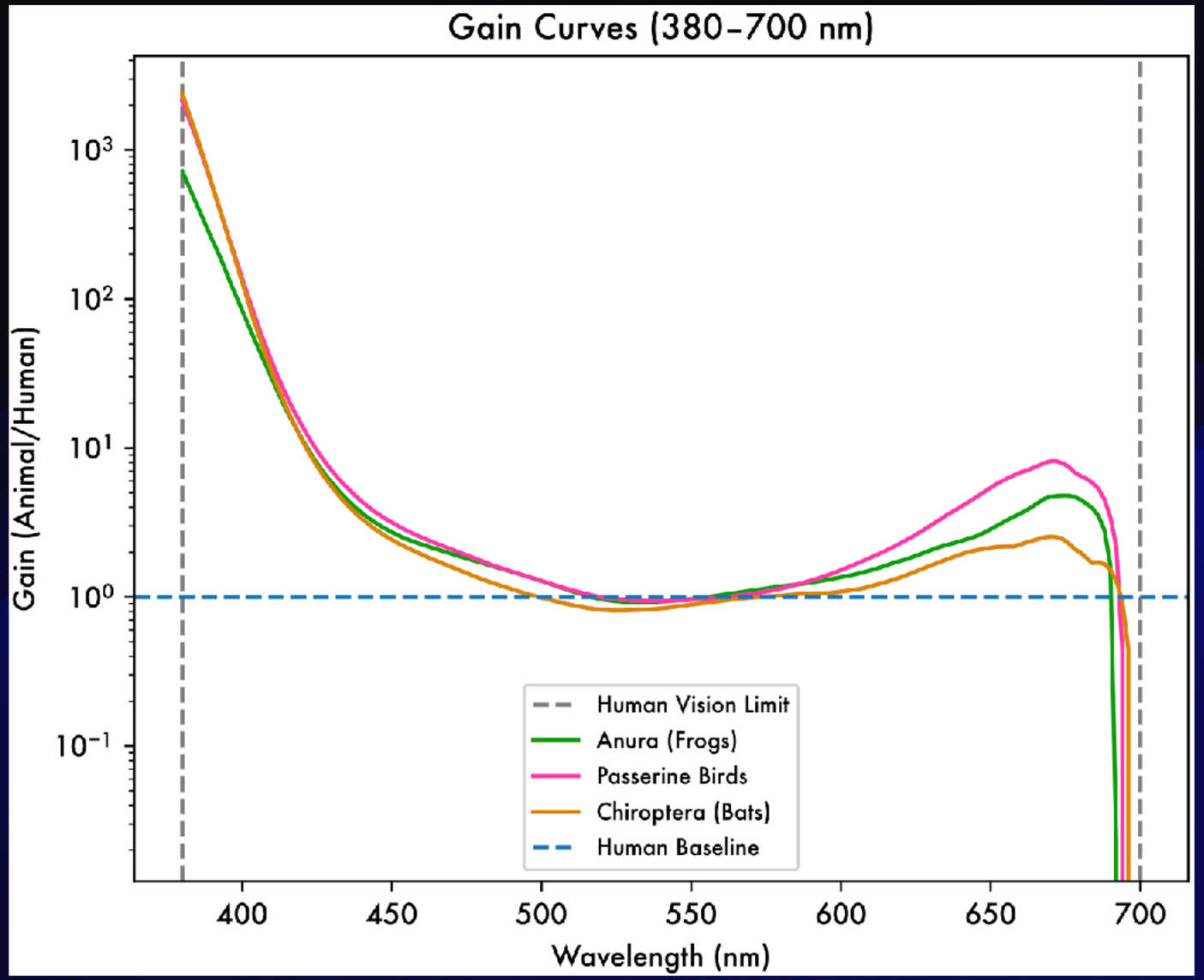
- Measurement of visual photopigment sensitivity
- Derivation of spectral sensitivity
- Compared to human vision

➡Relative gain curve

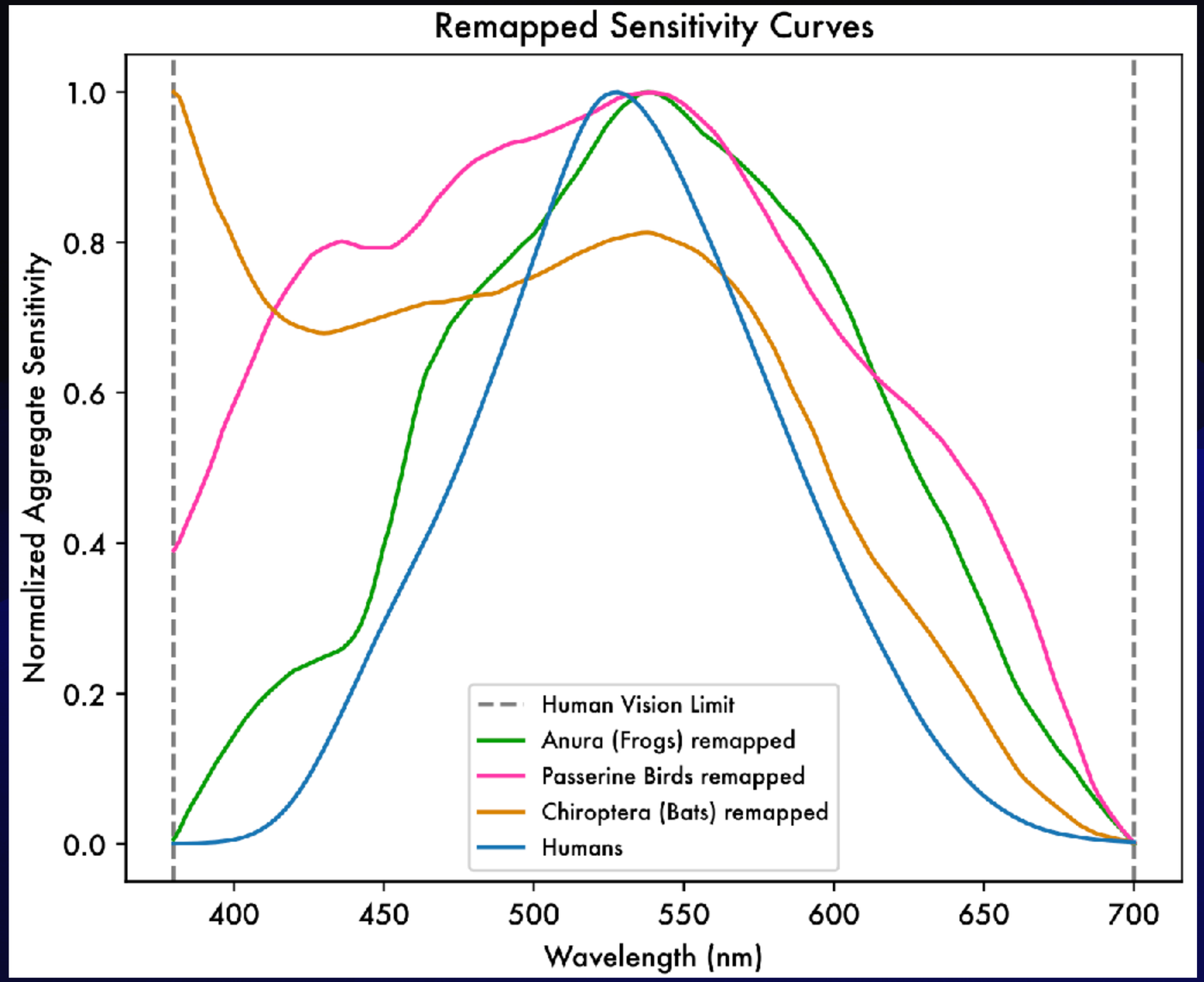


Visualizing animal light perception

- Measurement of visual photopigment sensitivity
- Derivation of spectral sensitivity
- Compared to human vision

➡Relative gain curve

➡Remap to 380–700nm



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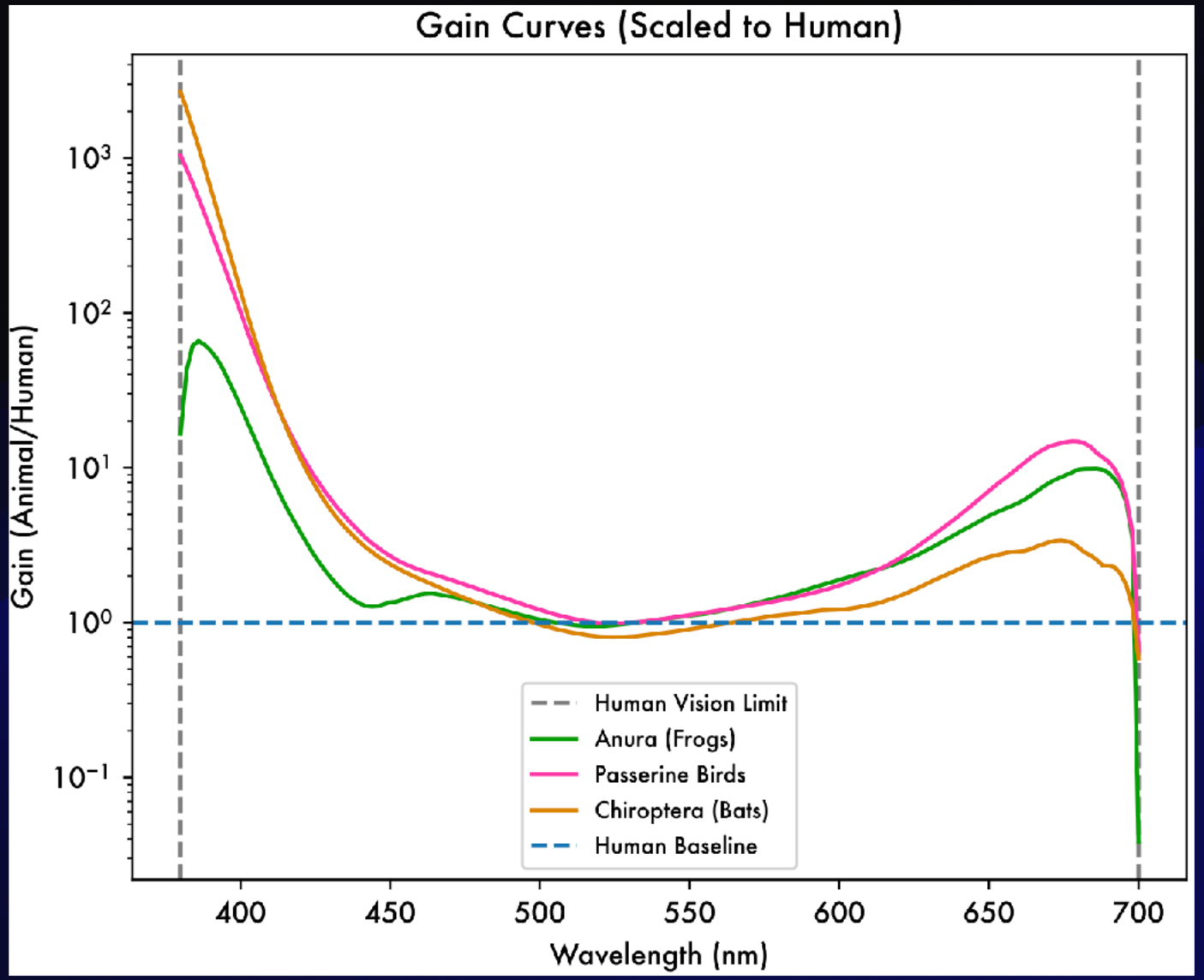

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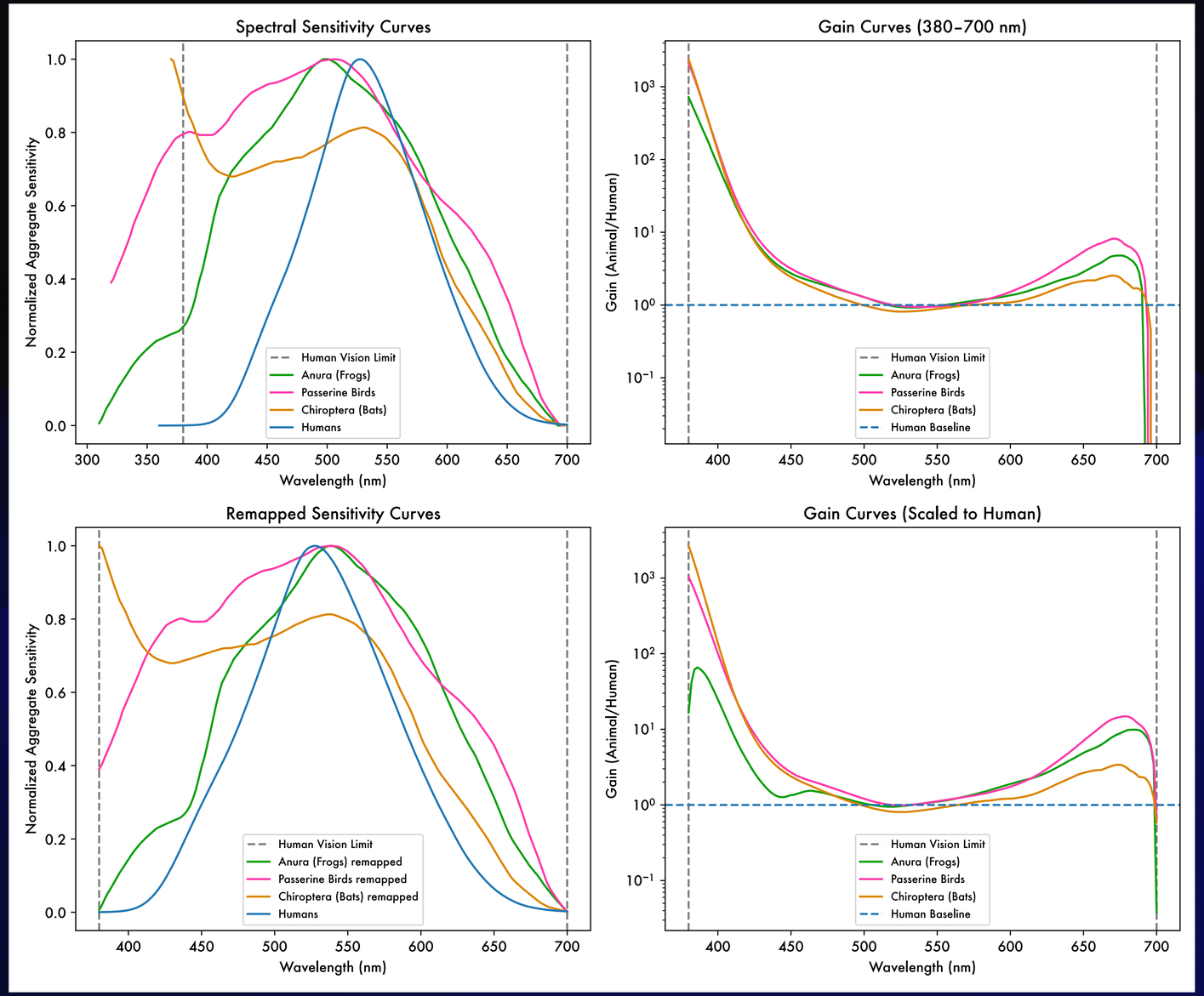
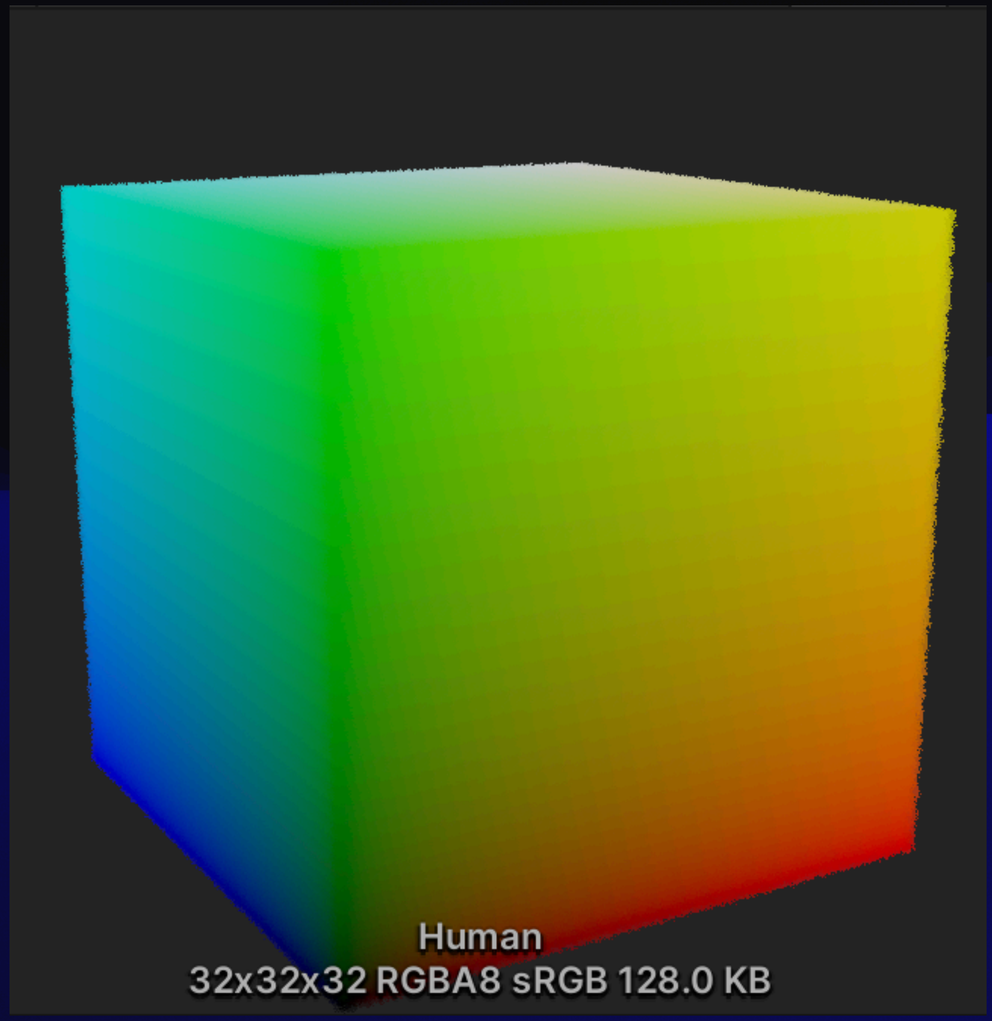


Visualizing animal light perception

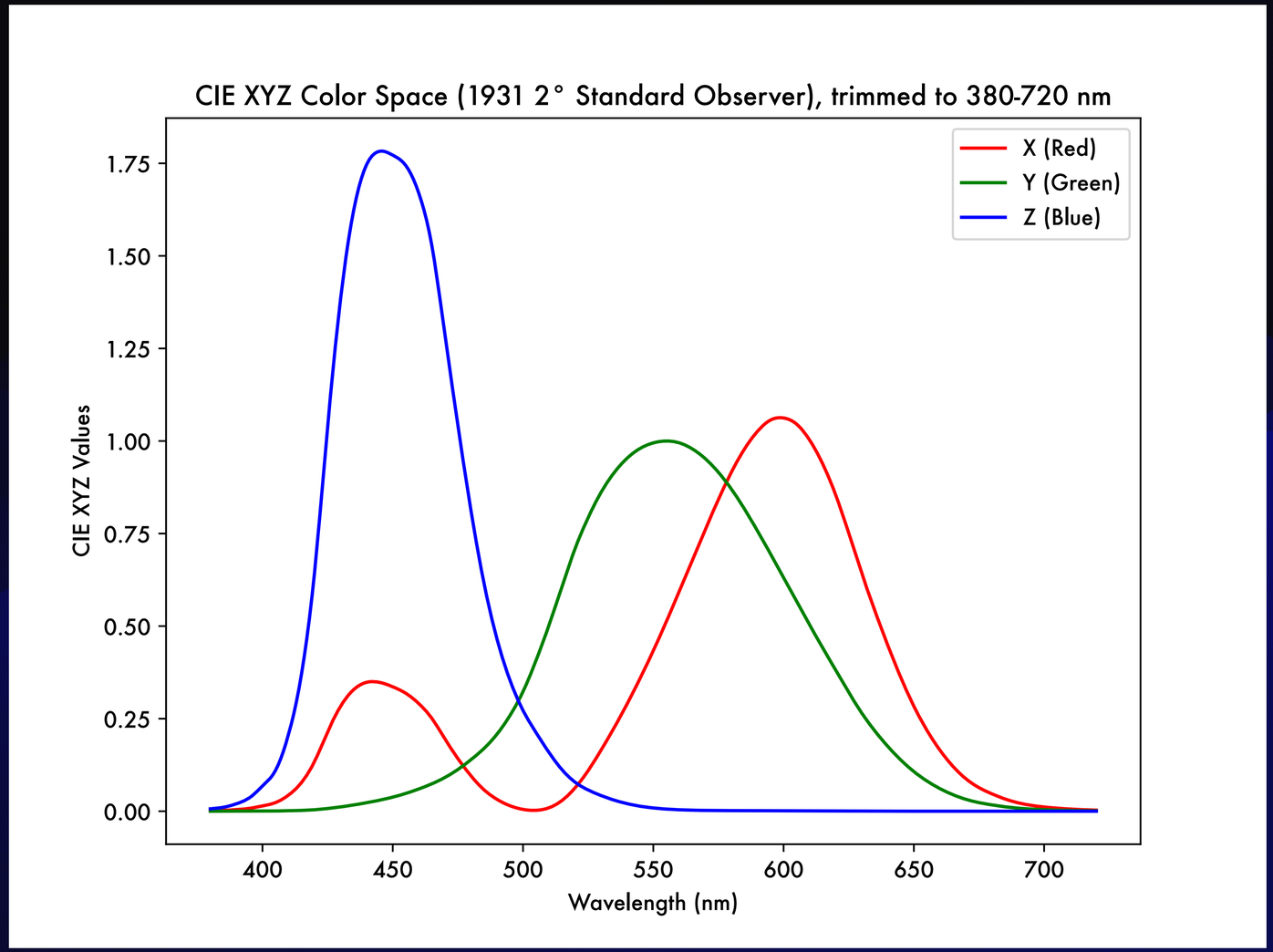
- Gain curves to LUTs



Unity 3D Look-Up-Table

Visualizing animal light perception

- Gain curves to LUTs
- Spectral deconstruction/ reconstruction
- sRGB to XYZ
- Gamma correction



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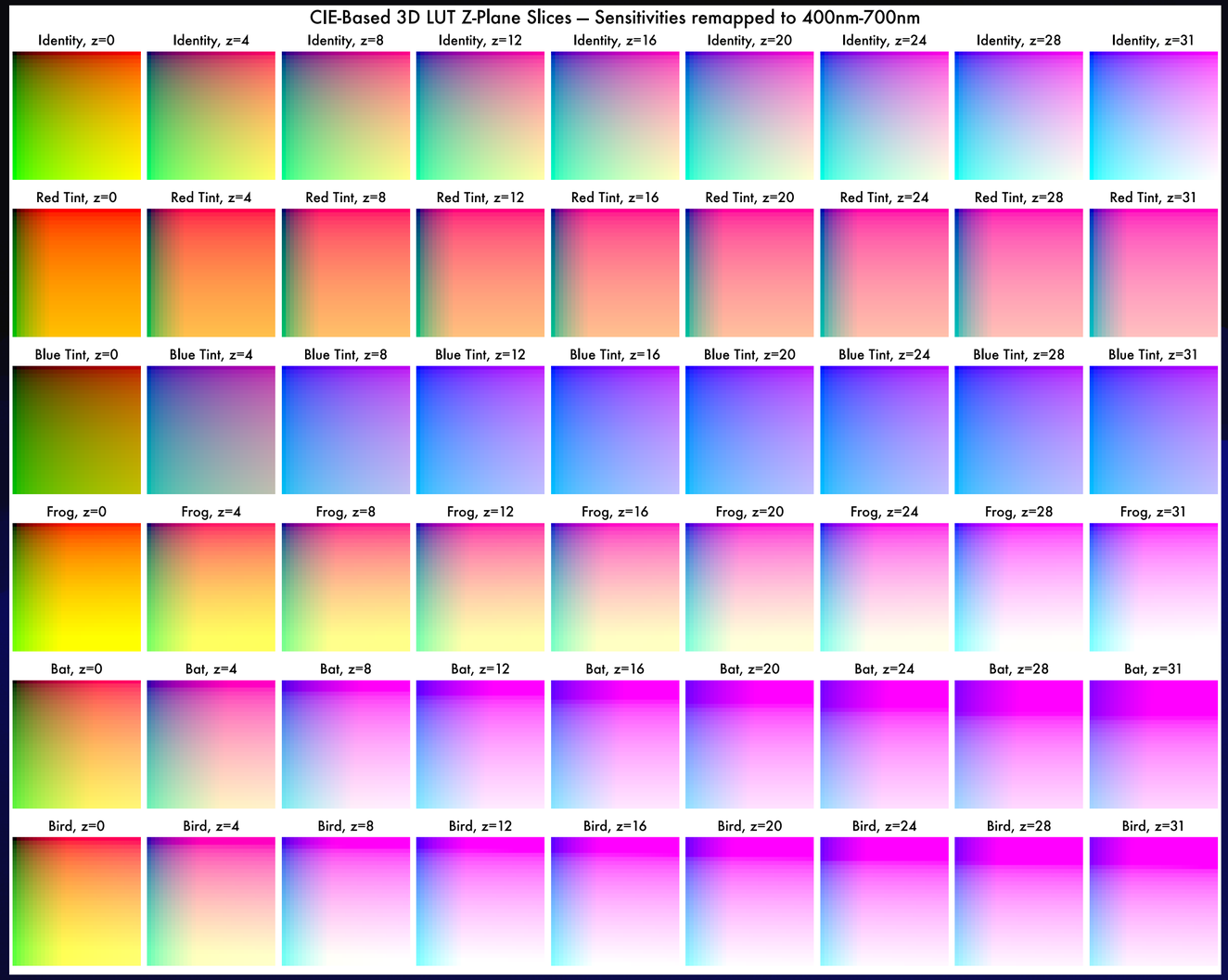

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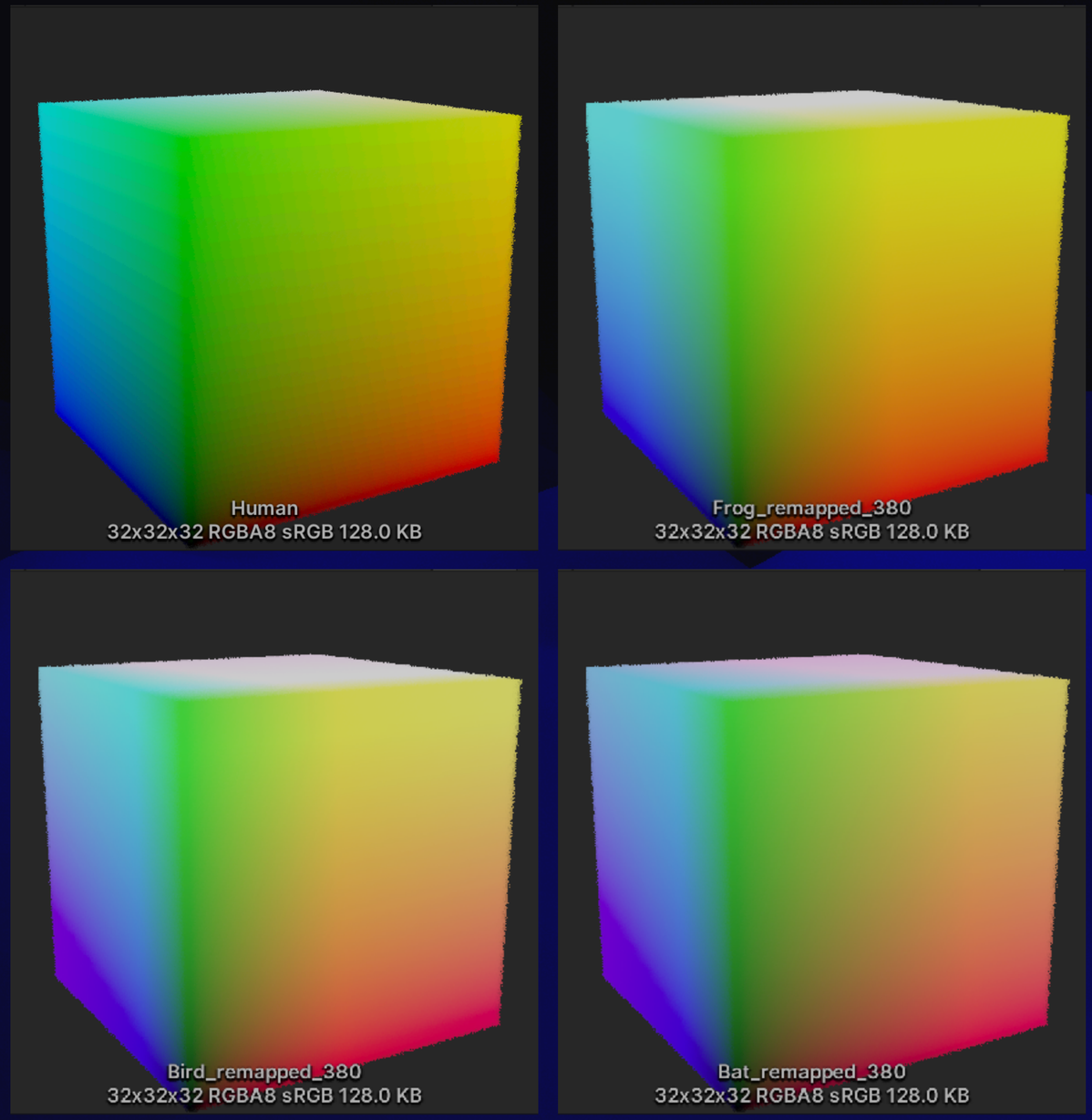
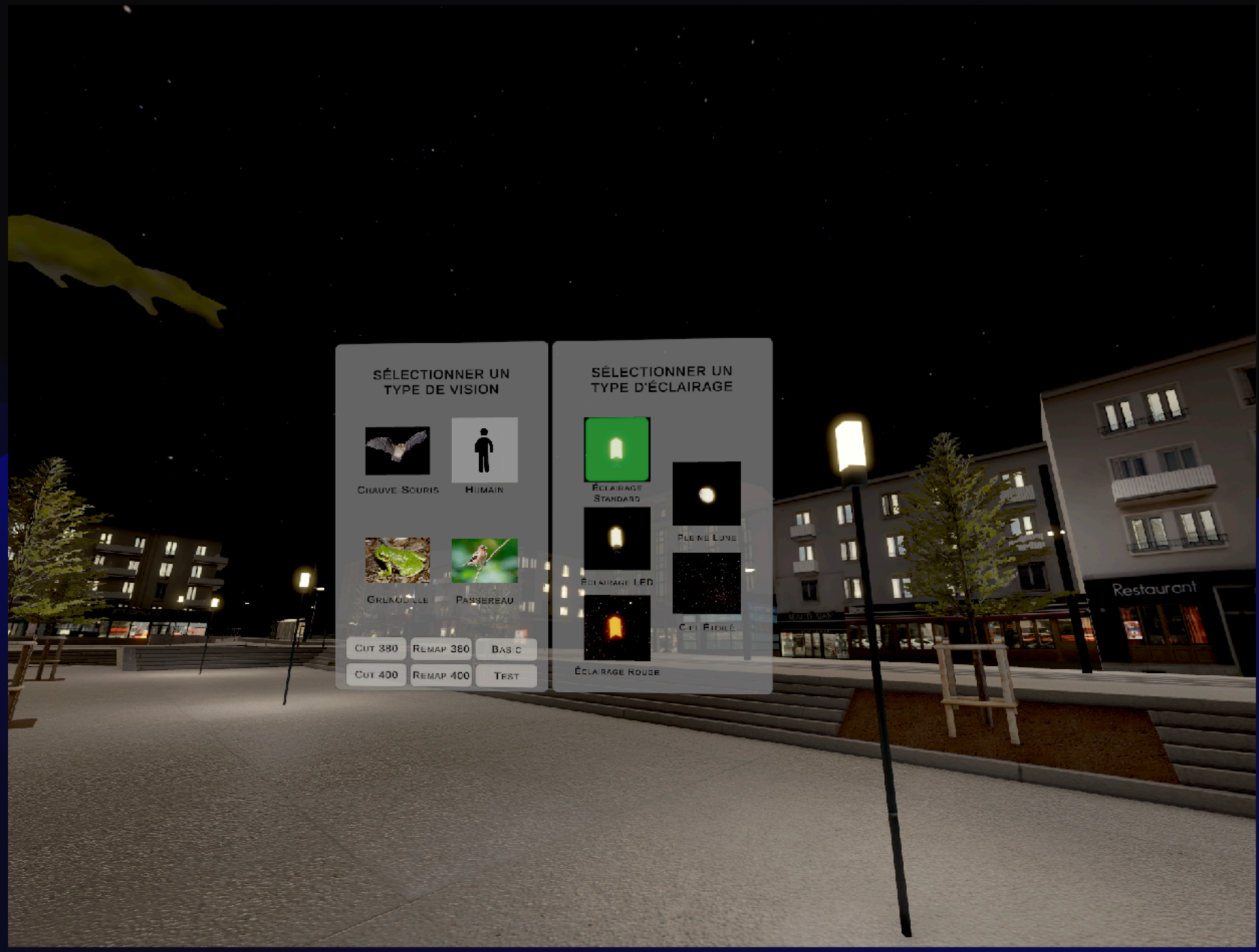


Visualizing animal light perception

- Gain curves to LUTs
- Spectral deconstruction/ reconstruction
- sRGB to XYZ
- Gamma correction
- Use as post-processing filter to simulate color/ light perception



Different combinations of lights, animals, and translation models

Future work

- More accurate lighting modeling — different graphics pipelines
- Different sensitivity mappings — scientific accuracy not as important as effective visualization

Future work

- **Hyperspectral visualization: currently limited to human-visible light — include UV imaging**

Thank you for your attention!

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