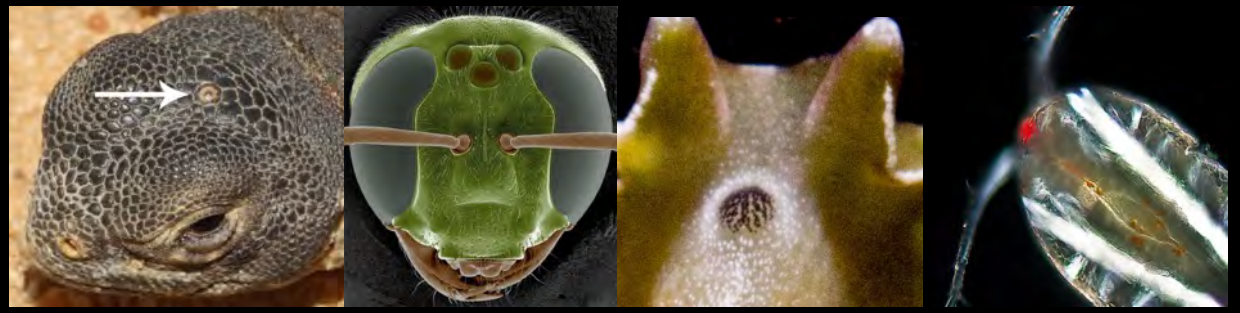
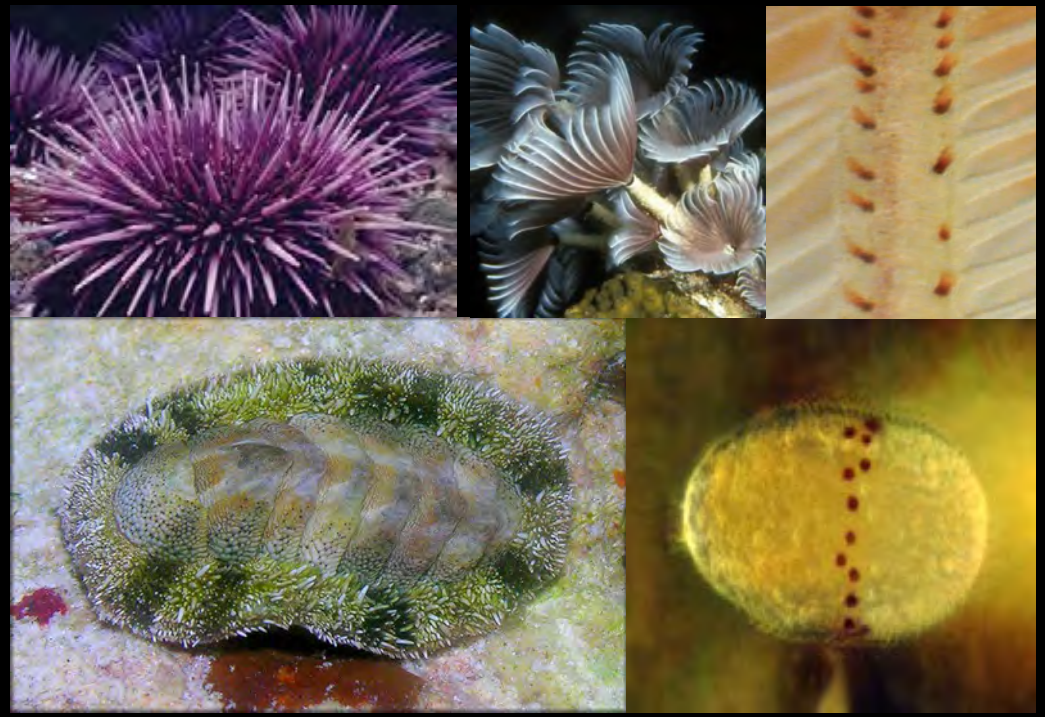
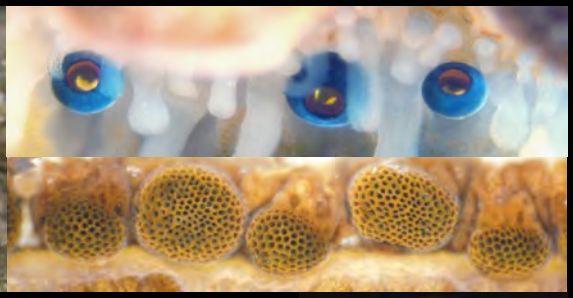
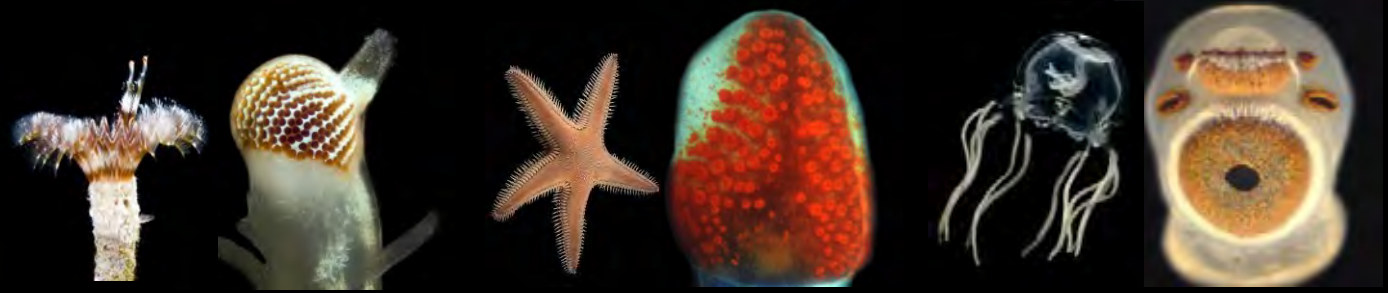
Vertical Light Gradients Control our Mind

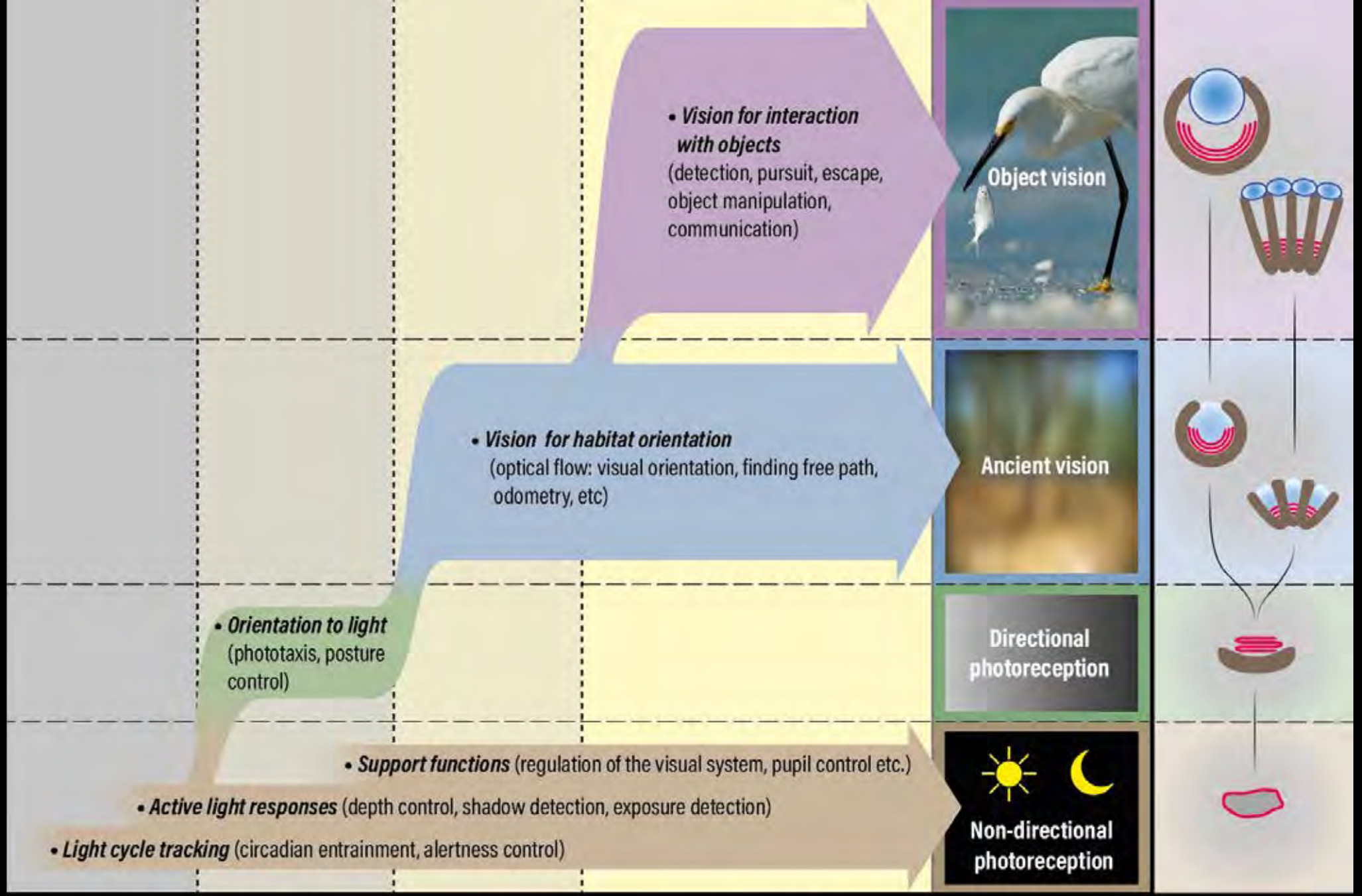
Dan-E. Nilsson

The Lund Vision Group



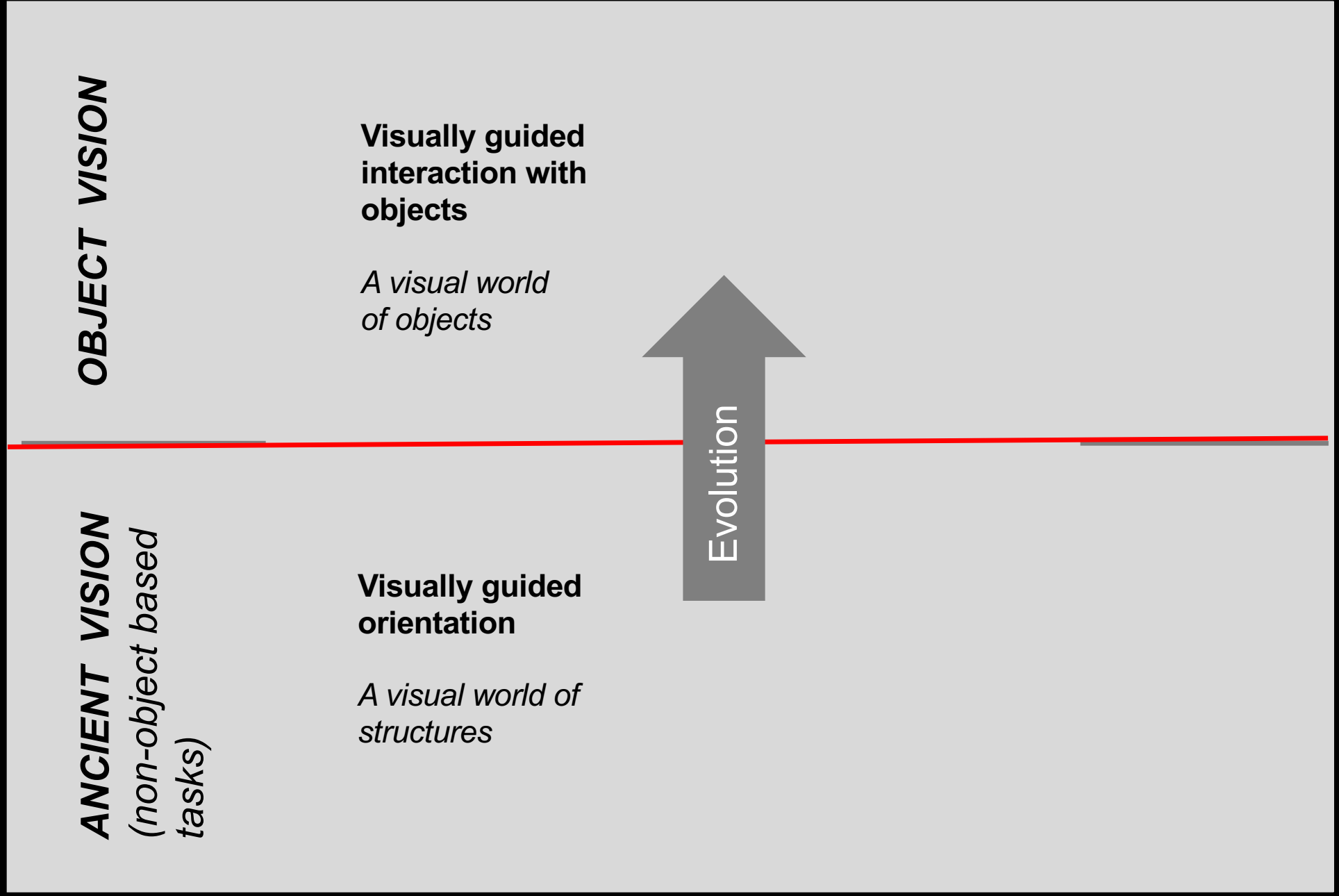


High resolution eyes

Low resolution eyes

Pigmented eye spots

Photo-receptor


OBJECT VISION
Visually guided interaction with objects
A visual world of objects
Evolution
ANCIENT VISION (non-object based tasks)
Visually guided orientation
A visual world of structures

ACTION VISION

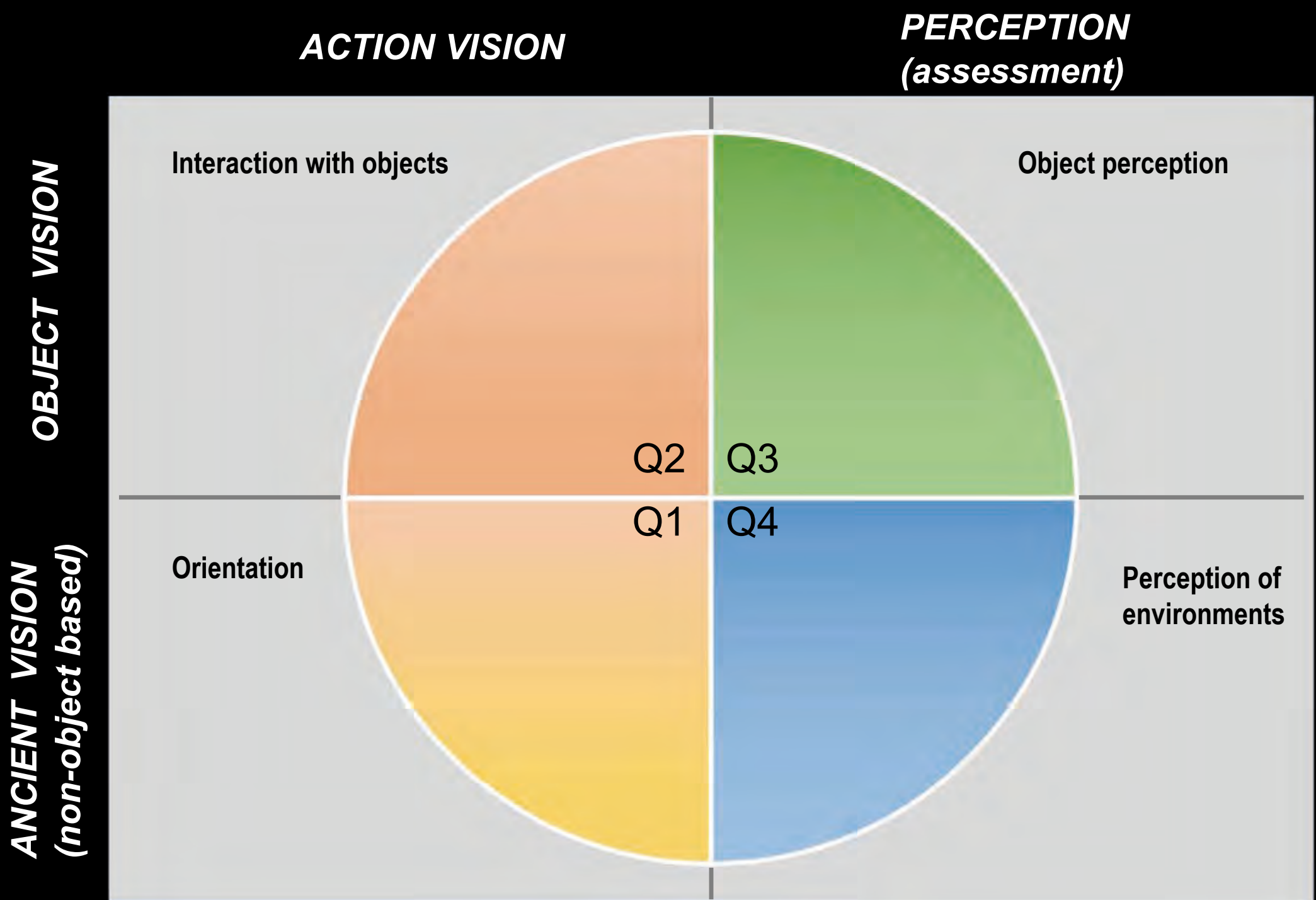
(see and act)

For direct guidance of actions in a closed feed-back loop

PERCEPTION

(assessment of the environment)

For visual evaluation of the world, with possible influence on behaviour at time perspectives from very short to very long


ACTION VISION
PERCEPTION
(assessment)
OBJECT VISION
ANCIENT VISION
(non-object based)
Interaction with objects
Object perception
Orientation
Perception of
environments
Q2
Q3
Q1
Q4

ACTION VISION

PERCEPTION (assessment)

OBJECT VISION

ANCIENT VISION (non-object based)

Interaction with objects

Object perception

Q2

Q3

Q1

Q4

Orientation

Perception of environments

Contrasting structures

ACTION VISION

PERCEPTION (assessment)

OBJECT VISION

ANCIENT VISION (non-object based)

Interaction with objects

Object perception

Q2

Q3

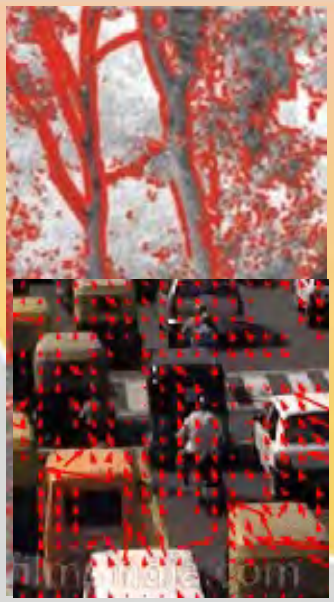
Q1

Q4

Orientation

Perception of environments

Contrasting structures
Optic flow



ACTION VISION

PERCEPTION
(assessment)

OBJECT VISION

ANCIENT VISION
(non-object based)

Interaction with objects

Object
segmentation
Recognition

Object perception

Q2

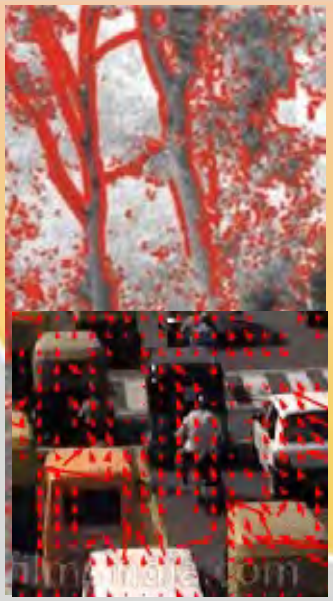
Q3

Q1

Q4

Orientation

Contrasting
structures
Optic flow



Perception of
environments

ACTION VISION

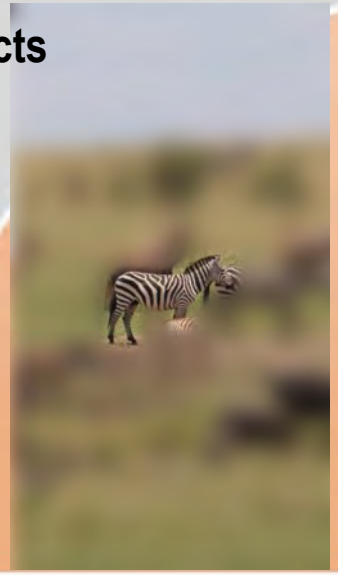
PERCEPTION (assessment)

OBJECT VISION

ANCIENT VISION (non-object based)

Interaction with objects

Object segmentation
Recognition
Attention



Object perception

Q2

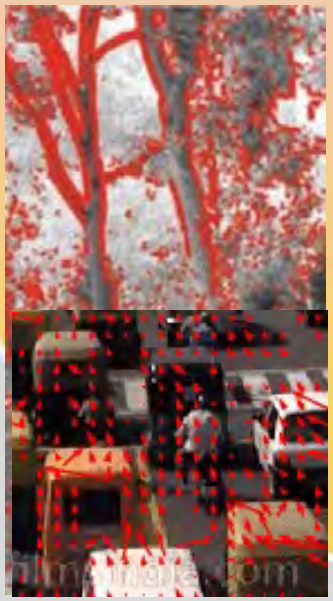
Q3

Q1

Q4

Orientation

Contrasting structures
Optic flow



Perception of environments

ACTION VISION

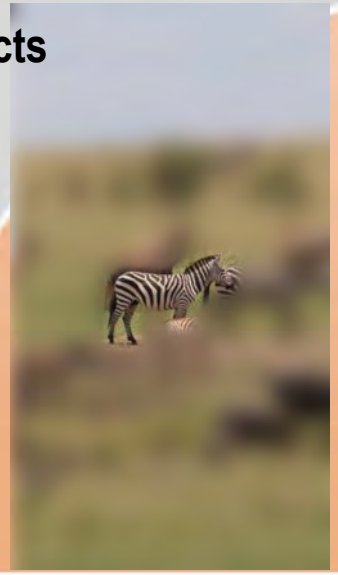
PERCEPTION (assessment)

OBJECT VISION

ANCIENT VISION (non-object based)

Interaction with objects

Object segmentation
Recognition
Attention



Q2

Object perception

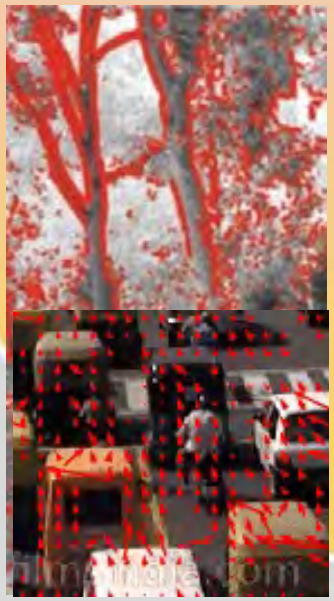
Object segmentation
Classification

Q3

Q1

Orientation

Contrasting structures
Optic flow



Q4

Perception of environments

ACTION VISION

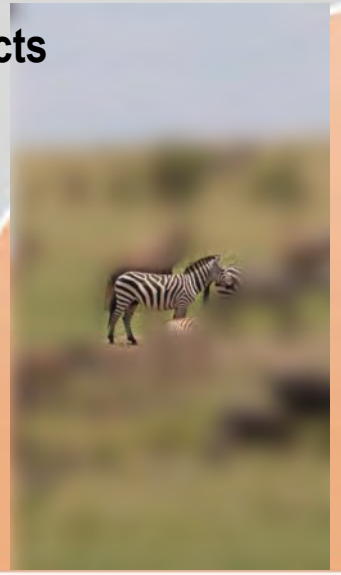
PERCEPTION (assessment)

OBJECT VISION

ANCIENT VISION (non-object based)

Interaction with objects

Object segmentation
Recognition
Attention



Q2

Object perception

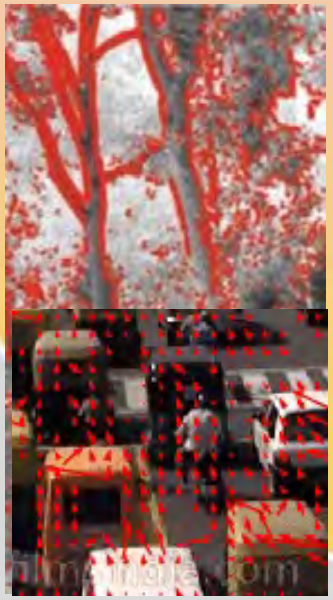
Object segmentation
Classification

Q3

Q1

Orientation

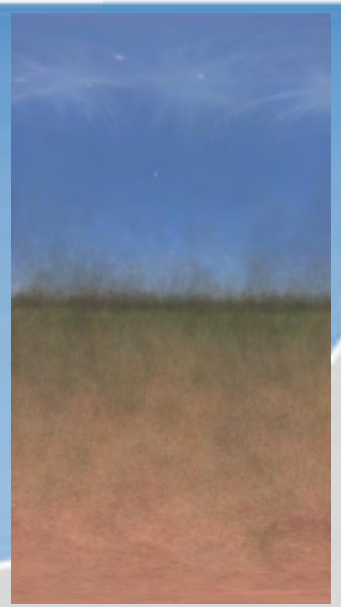
Contrasting structures
Optic flow

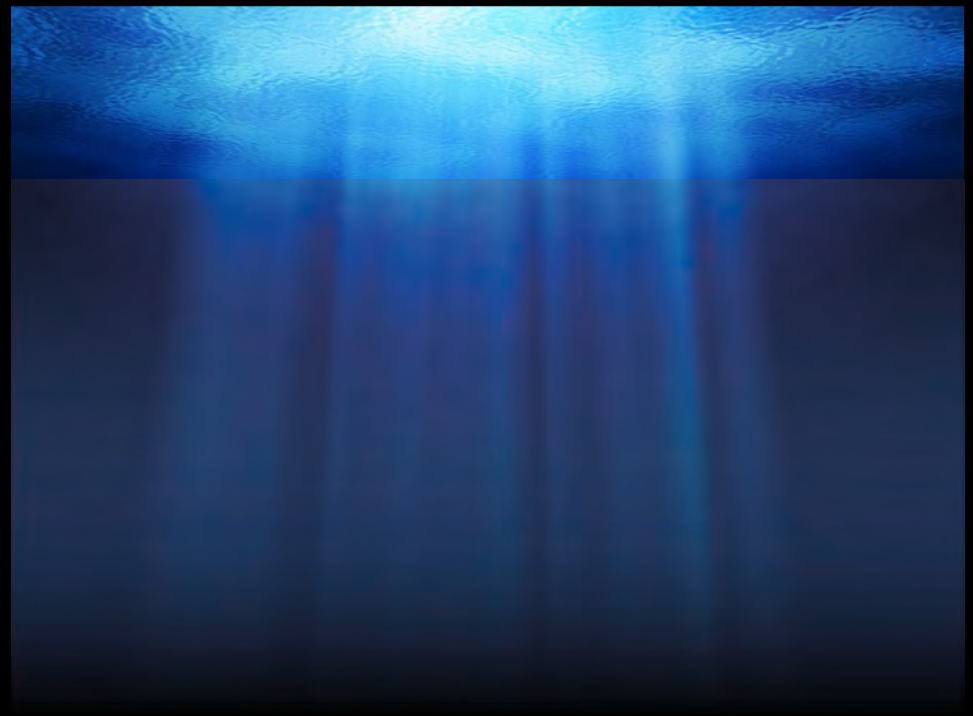


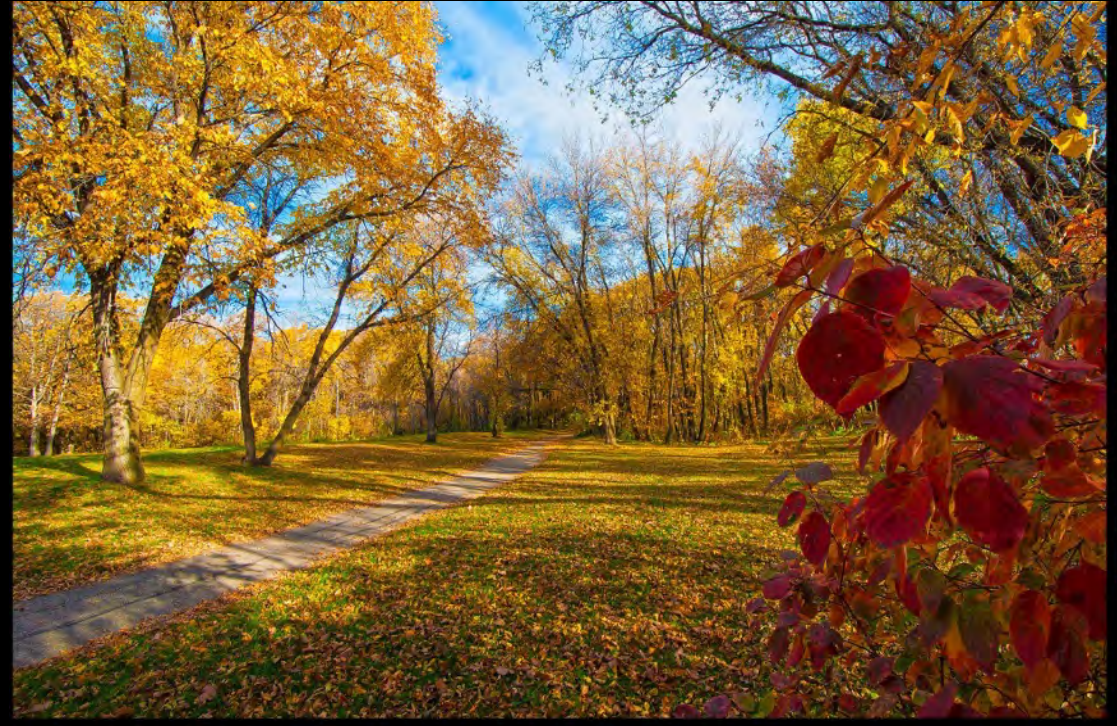
Q4

Perception of environments

Distribution of light, colour, and structure








Adobe Stock | #224851765


a


b

Depending on the environment and its conditions, all animals need to select habitat and choose from their behavioral repertoire - SETTING A MOTIVATIONAL STATE FOR SUITABLE ACTIVITIES (BEHAVIORAL STATE)

- Searching for good habitats
- Search for food, pursue prey
- Protect against threats, escape from danger
- Interactions with individuals of the same species to keep territories, promote social status, reproduce or care for offspring
- Grooming, cleaning
- Caring for nests, burrows, or shelters
- Resting, sleeping

single scene

another single scene,
same environment

- SCENE-SPECIFIC INFORMATION
- ENVIRONMENT-TYPICAL INFORMATION

single scene

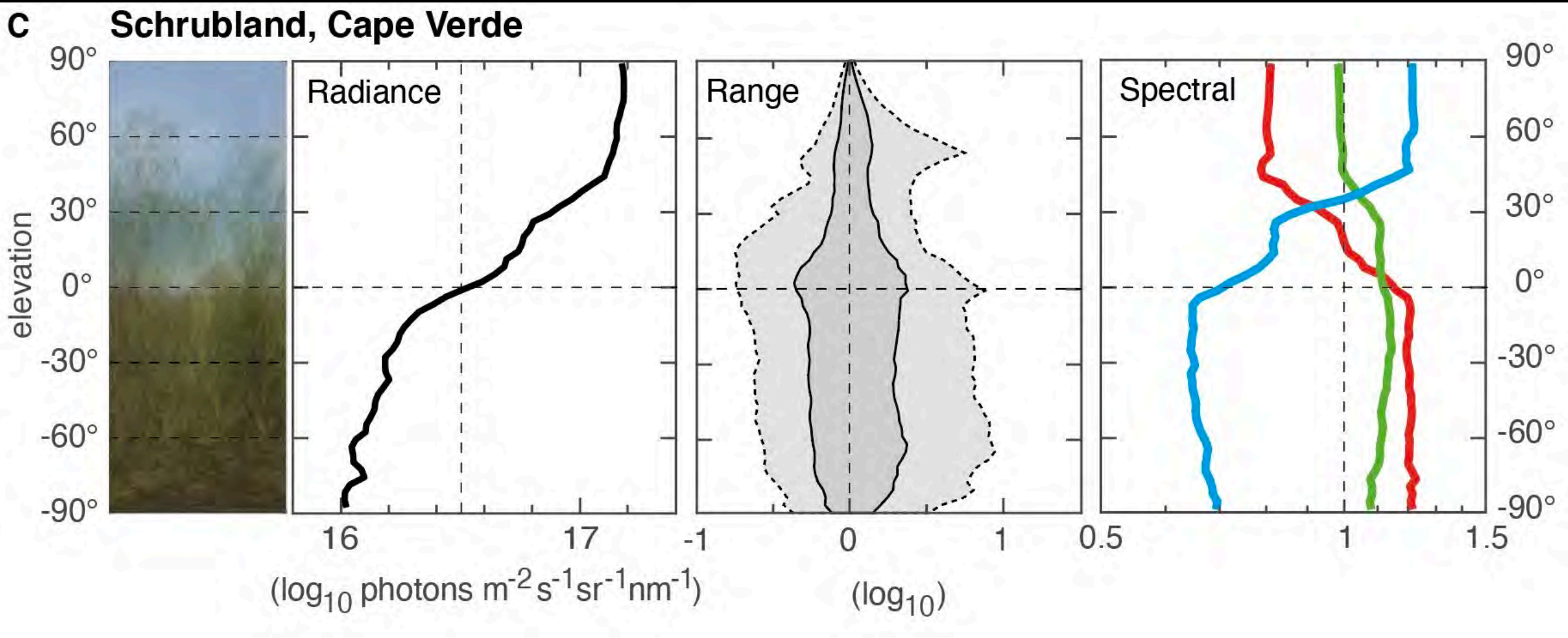
another single scene,
same environment

Average over many
scenes to get environment-
typical features

This is what an imaging system with slow neurons would integrate over time

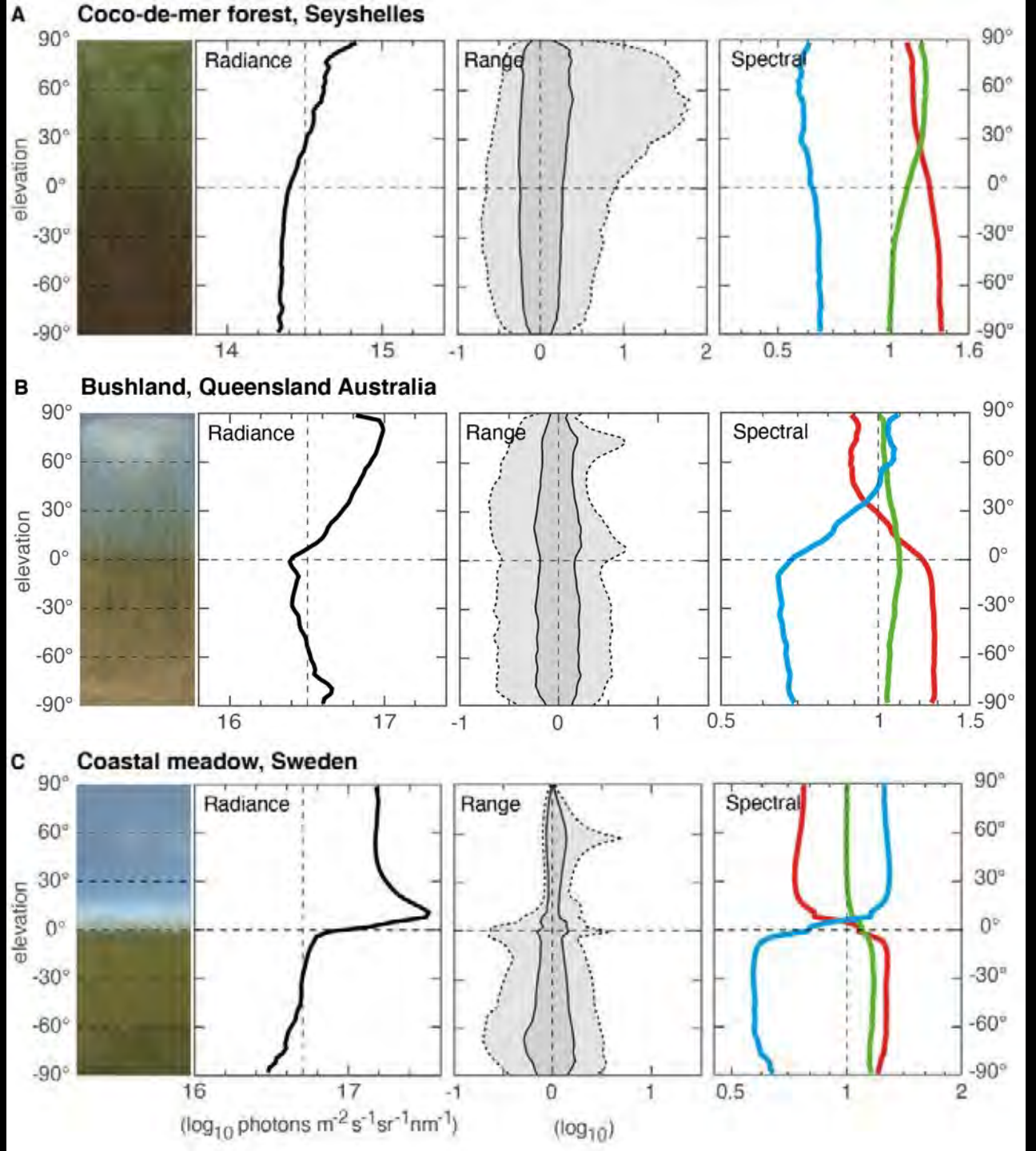
- SCENE-SPECIFIC INFORMATION
- ENVIRONMENT-TYPICAL INFORMATION

VERTICAL LIGHT GRADIENTS

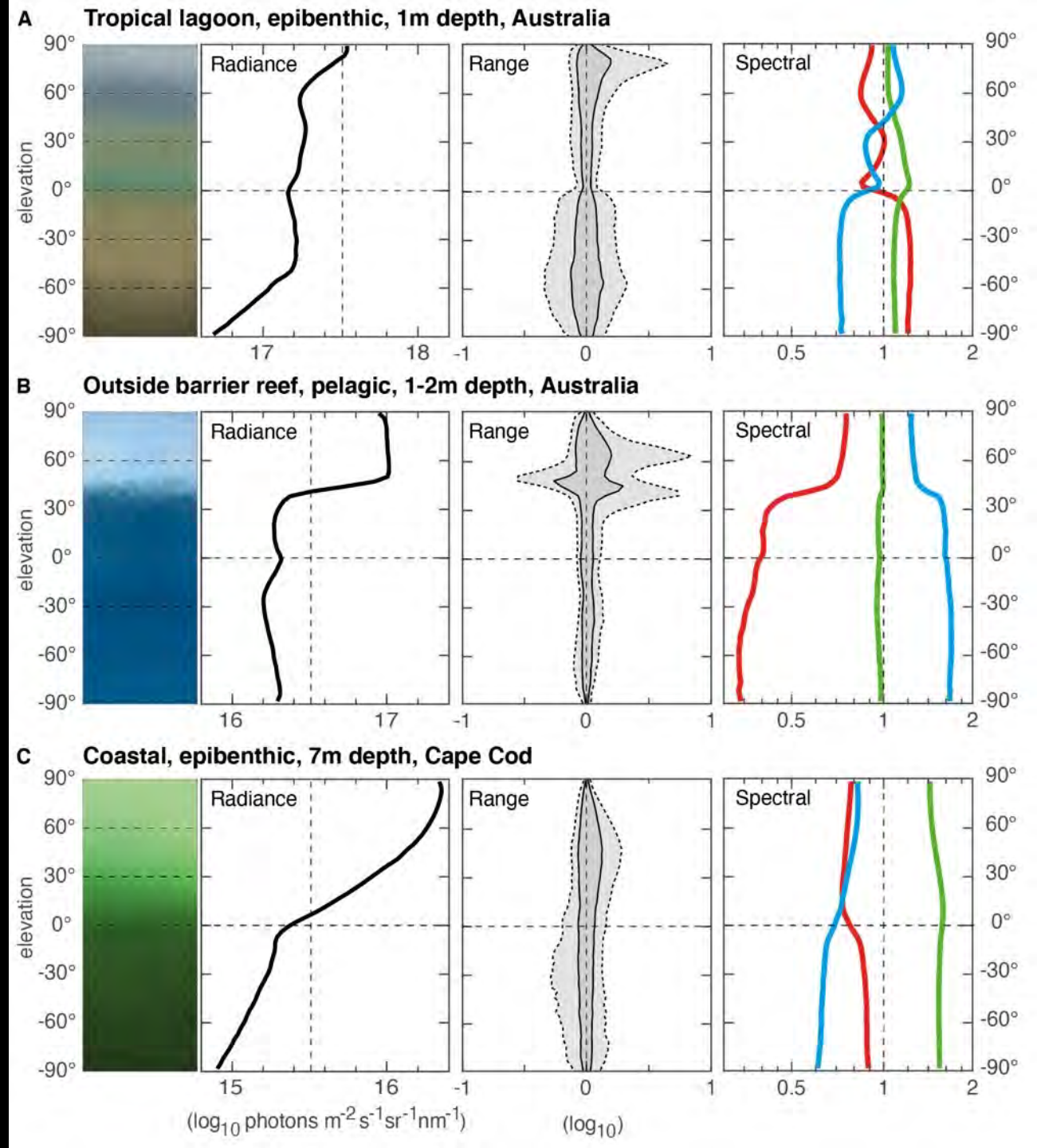


INTENSITY VISIBLE STRUCTURE SPECTRAL BALANCE

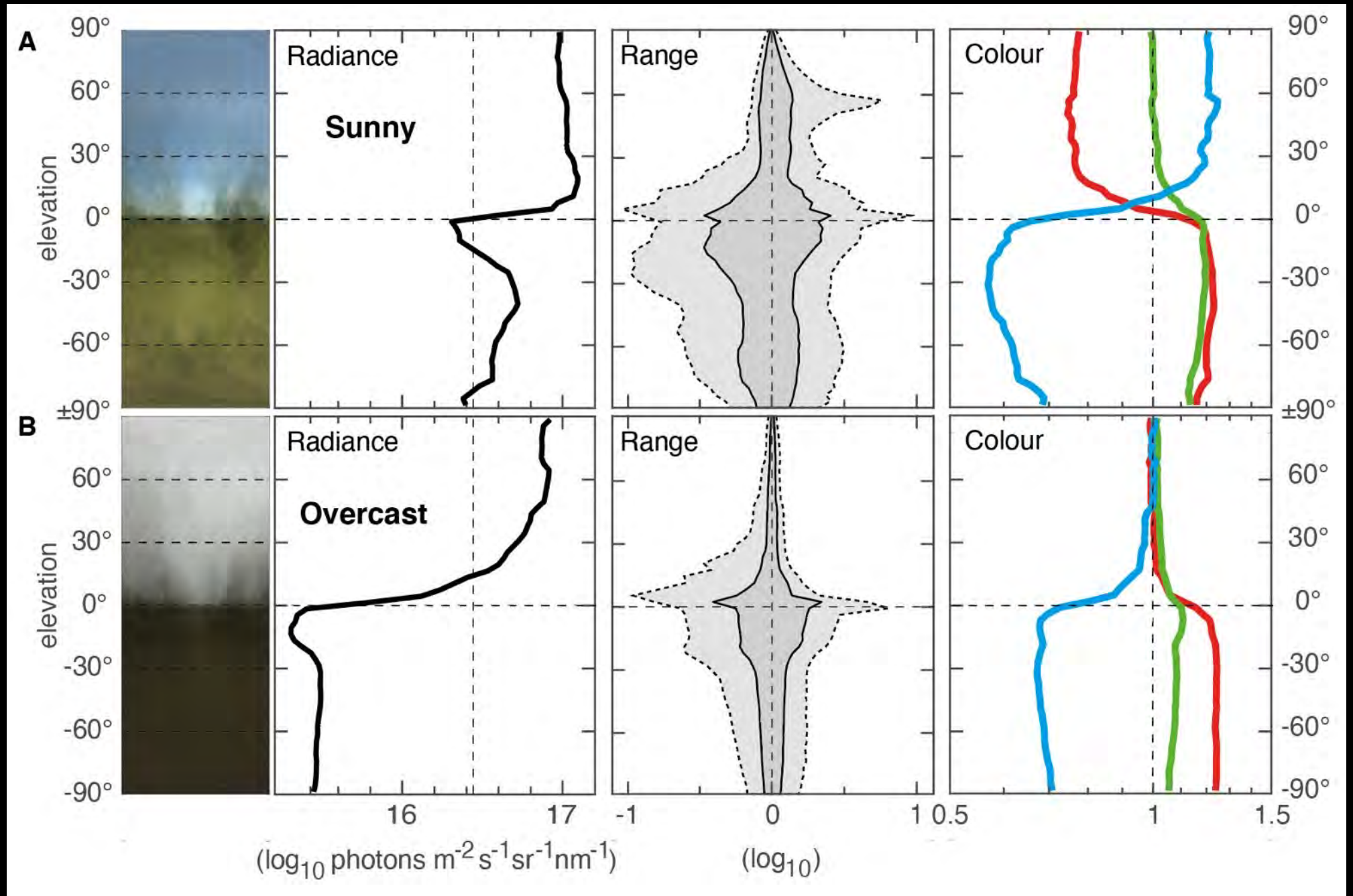
DIFFERENT ENVIRONMENTS



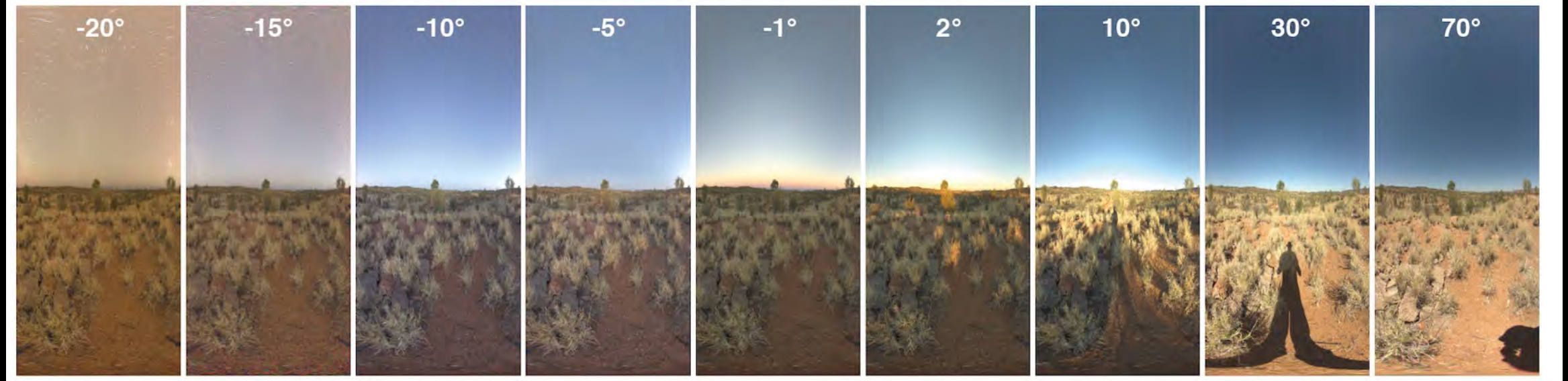
DIFFERENT ENVIRONMENTS UNDER WATER

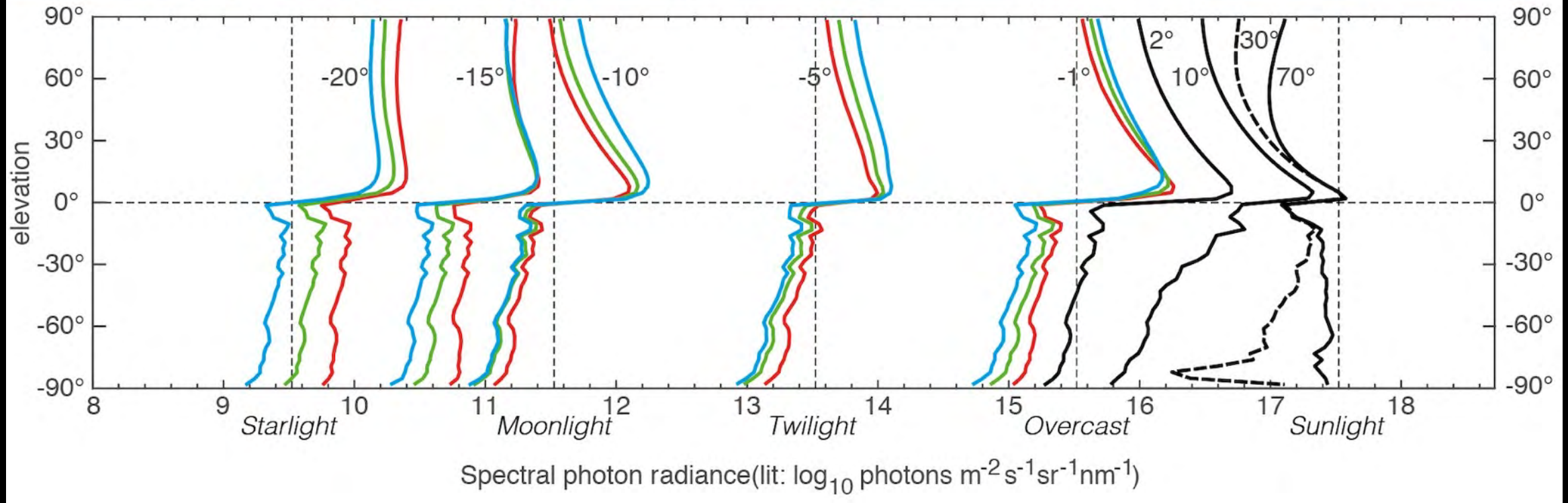


WEATHER

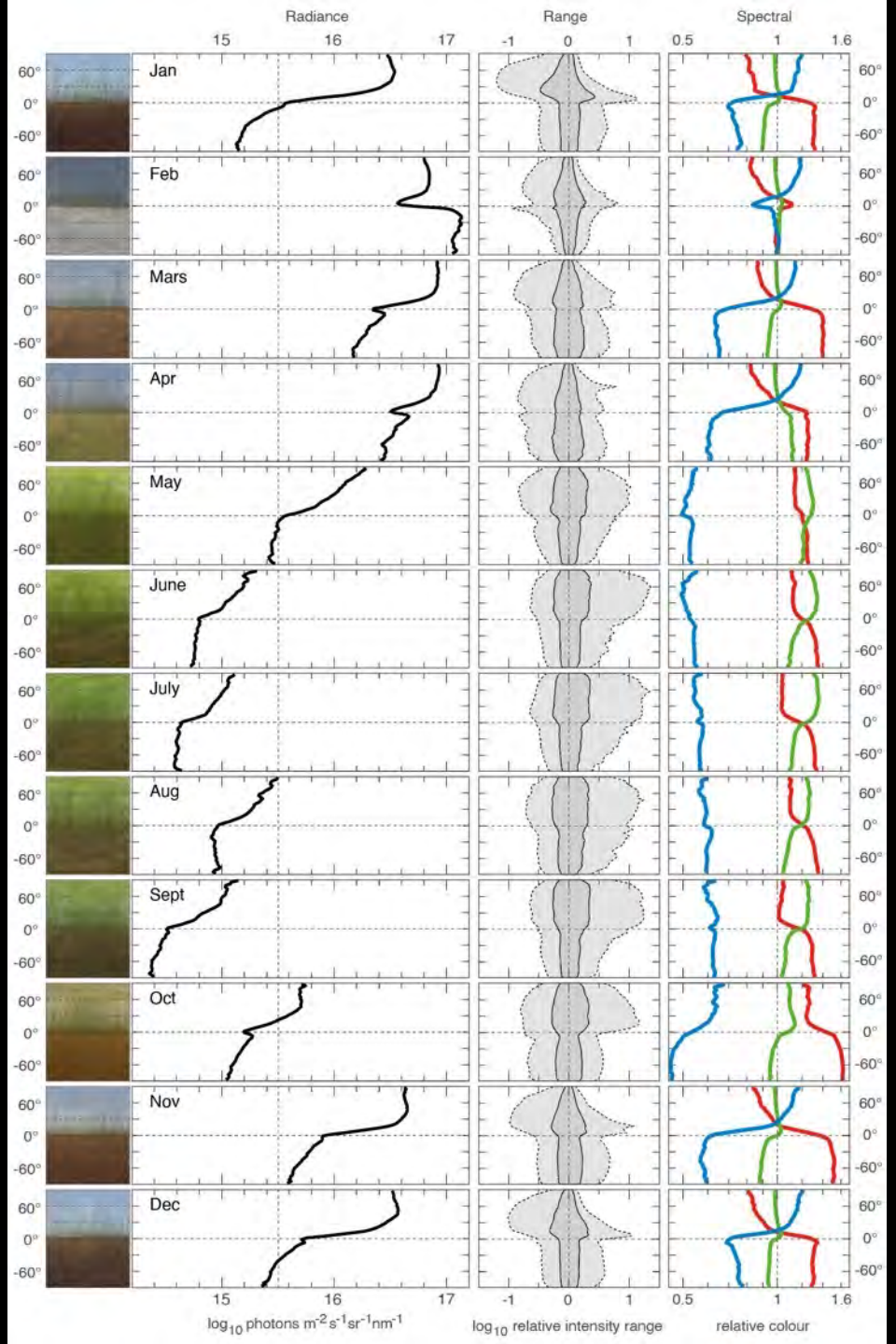

A
B
Radiance
Sunny
Range
Colour
Radiance
Overcast
Range
Colour
elevation
elevation
90°
60°
30°
0°
-30°
-60°
±90°
-90°
16
17
-1
0
1
0.5
1
1.5
(log10 photons m-2 s-1 sr-1 nm-1)
(log10)

TIME


-20°
-15°
-10°
-5°
-1°
2°
10°
30°
70°


90°
60°
30°
0°
-30°
-60°
-90°
elevation
-20°
-15°
-10°
-5°
-1°
2°
10°
30°
70°
8
9
10
11
12
13
14
15
16
17
18
Starlight
Moonlight
Twilight
Overcast
Sunlight
Spectral photon radiance(lit: log10 photons m-2 s-1 sr-1 nm-1)

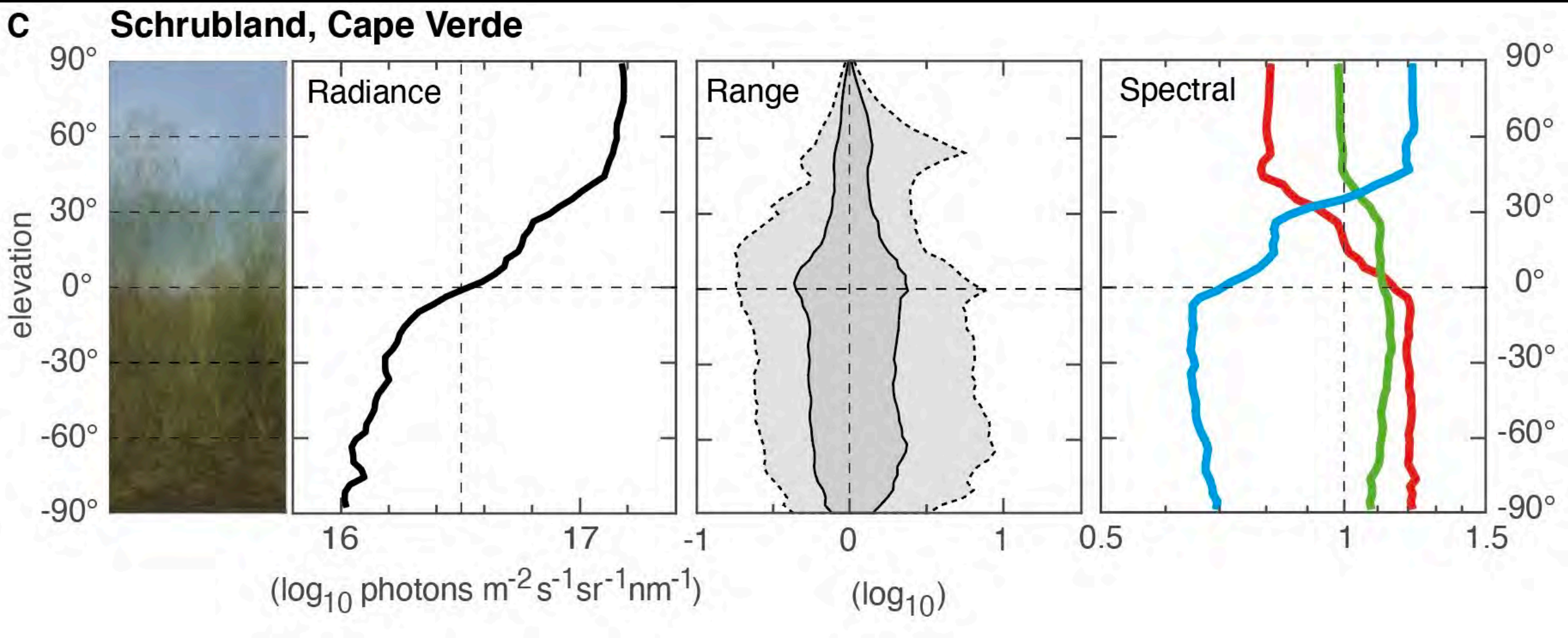
SEASONS


Radiance
Range
Spectral
15
16
17
-1
0
1
0.5
1
1.6
Jan
Feb
Mars
Apr
May
June
July
Aug
Sept
Oct
Nov
Dec
60°
0°
-60°
log10 photons m-2 s-1 sr-1 nm-1
log10 relative intensity range
relative colour

Essential aspects that can be read from the Vertical Light Gradient

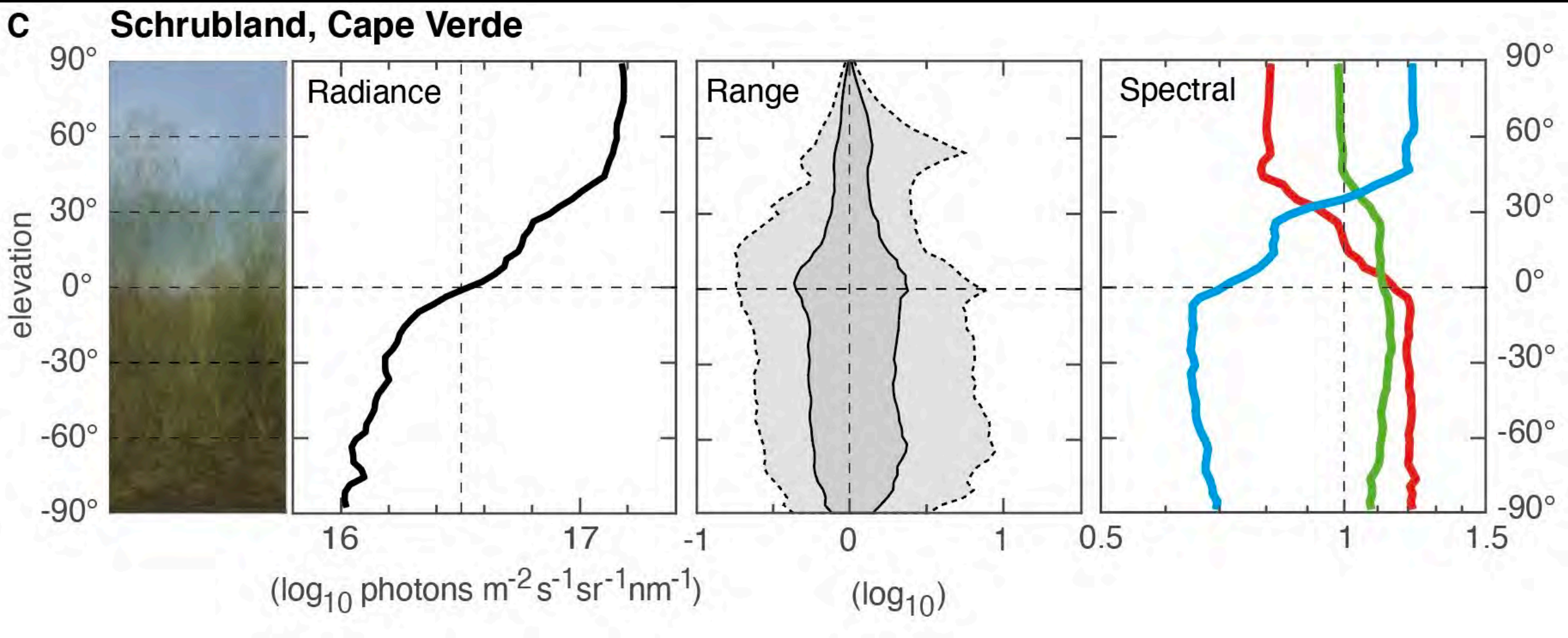
- Type of environment
- Weather conditions
- Time of day
- Season
- Depth in water (for aquatic animals)

VERTICAL LIGHT GRADIENTS



INTENSITY VISIBLE STRUCTURE SPECTRAL BALANCE

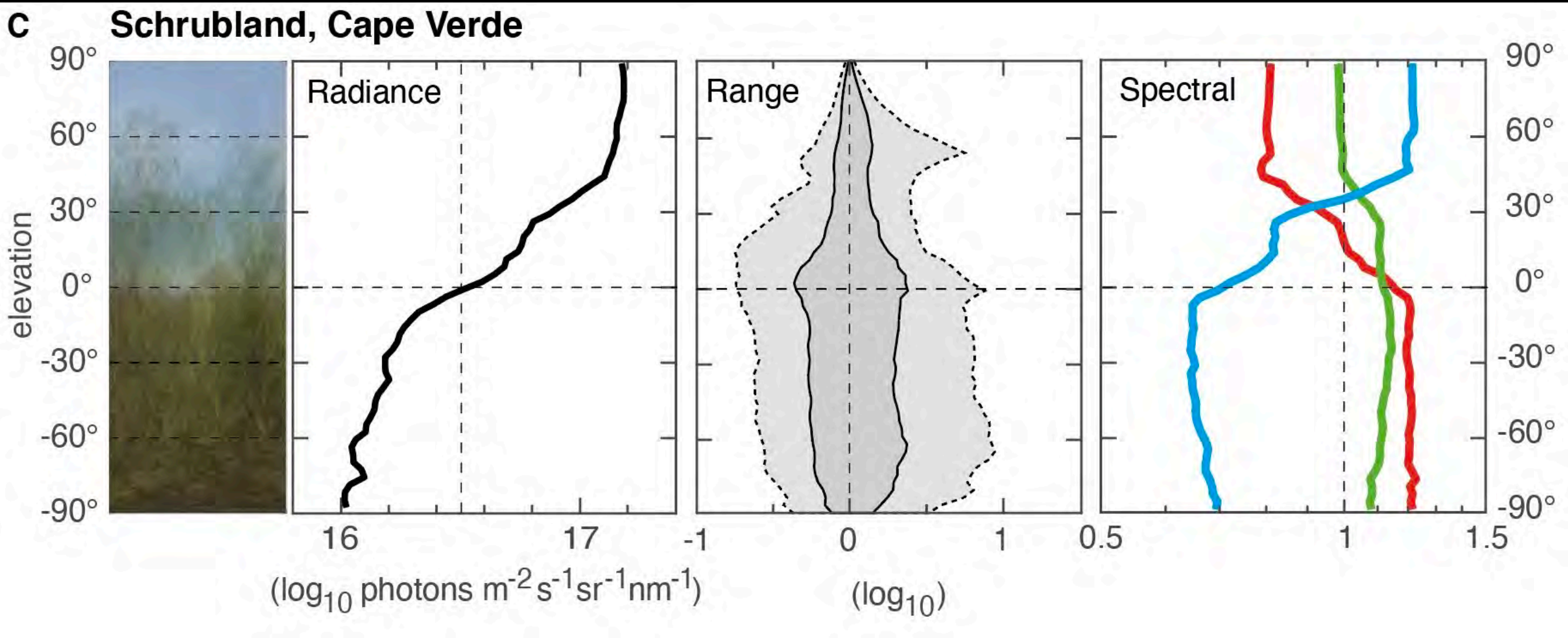
VERTICAL LIGHT GRADIENTS



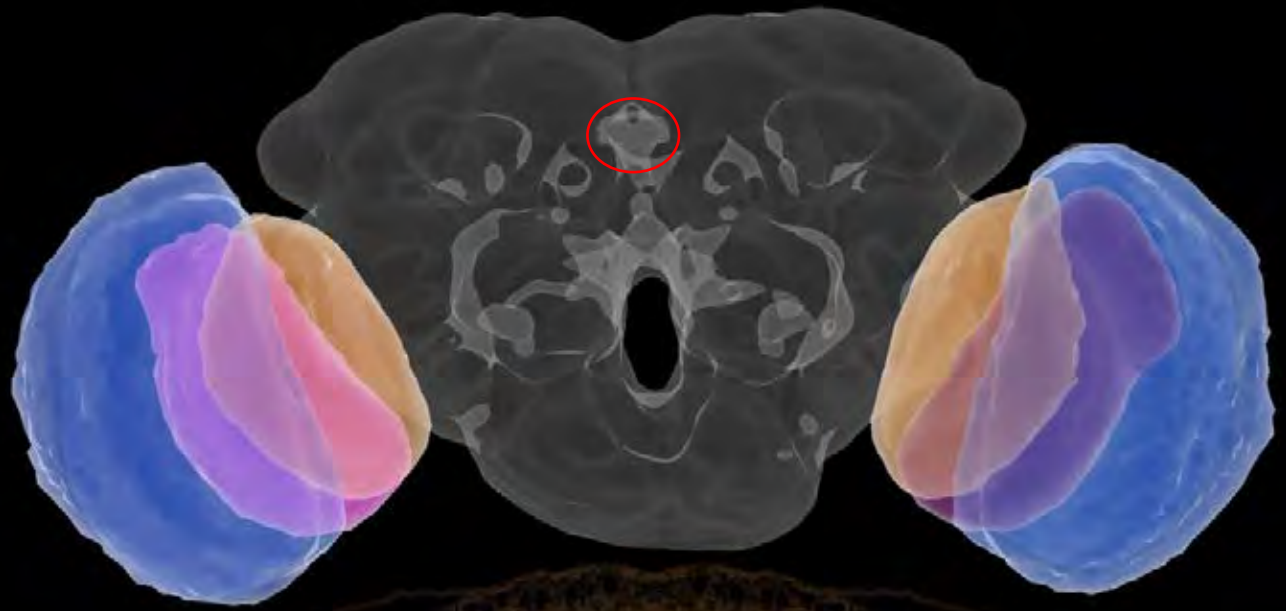
1. INTENSITY
2. VISIBLE STRUCTURE
3. SPECTRAL BALANCE

4. DYNAMICS (s)
5. DYNAMICS (min)
6. SCENE DEPTH

VERTICAL LIGHT GRADIENTS



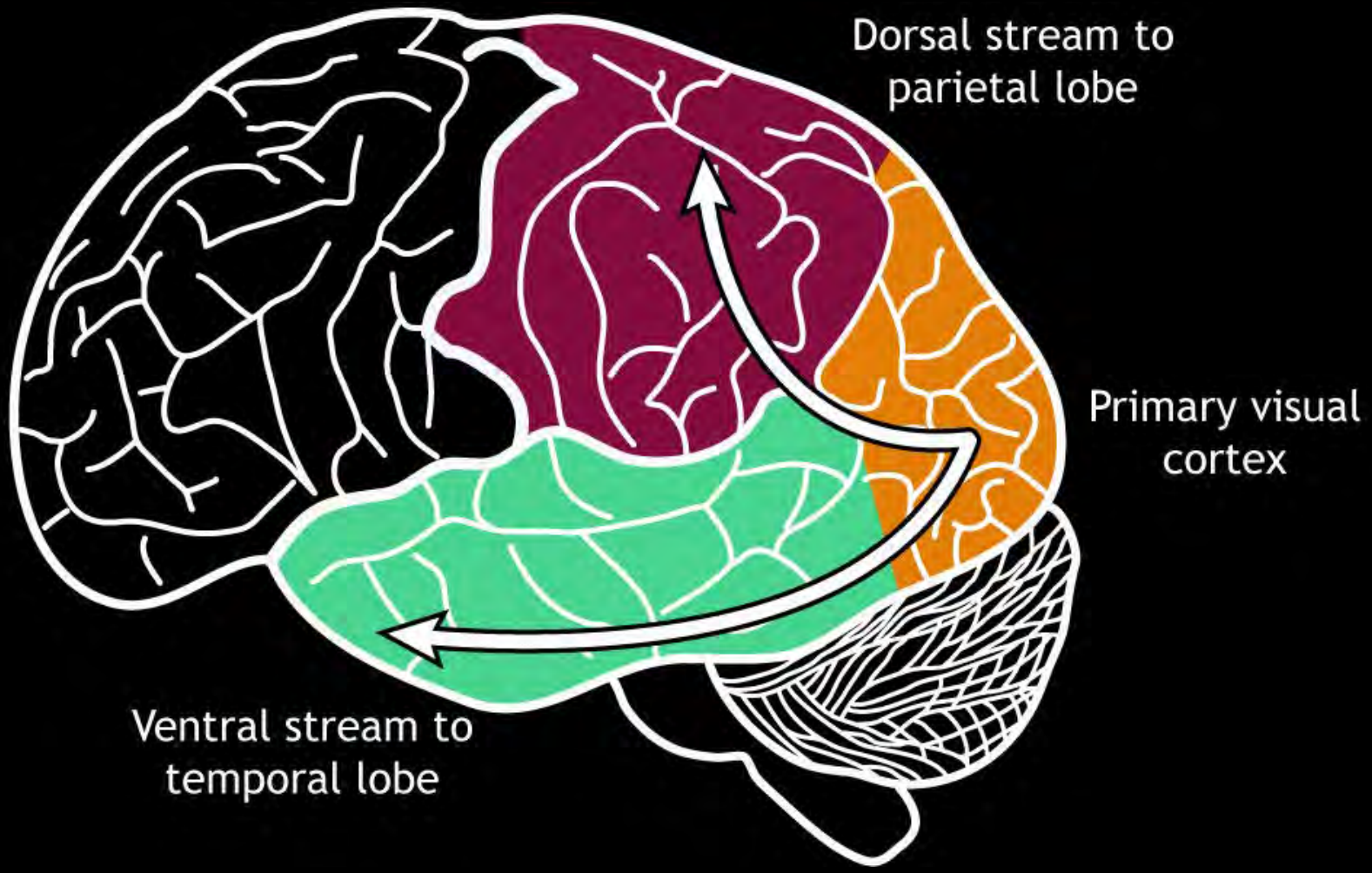
INTENSITY VISIBLE STRUCTURE SPECTRAL BALANCE

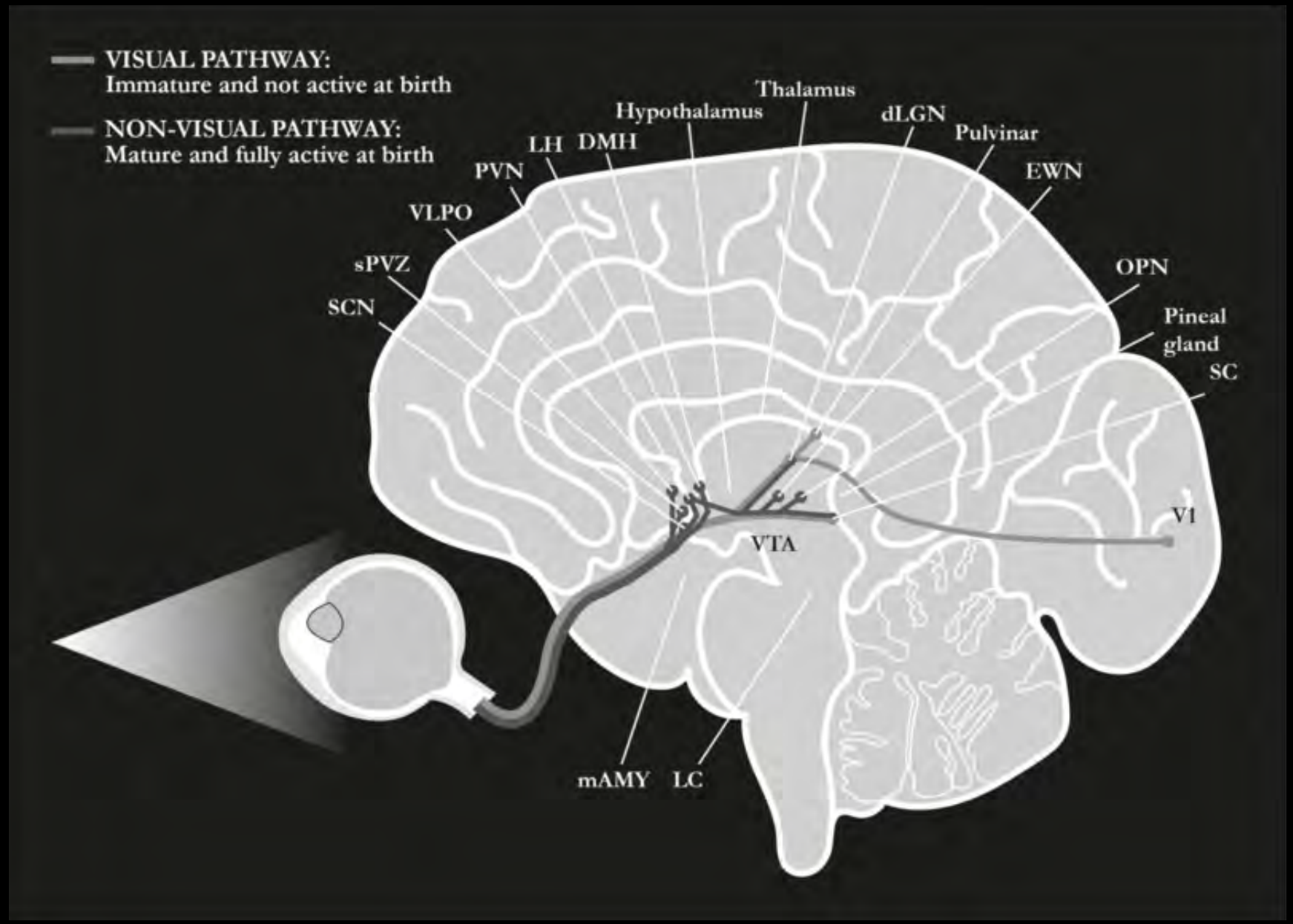


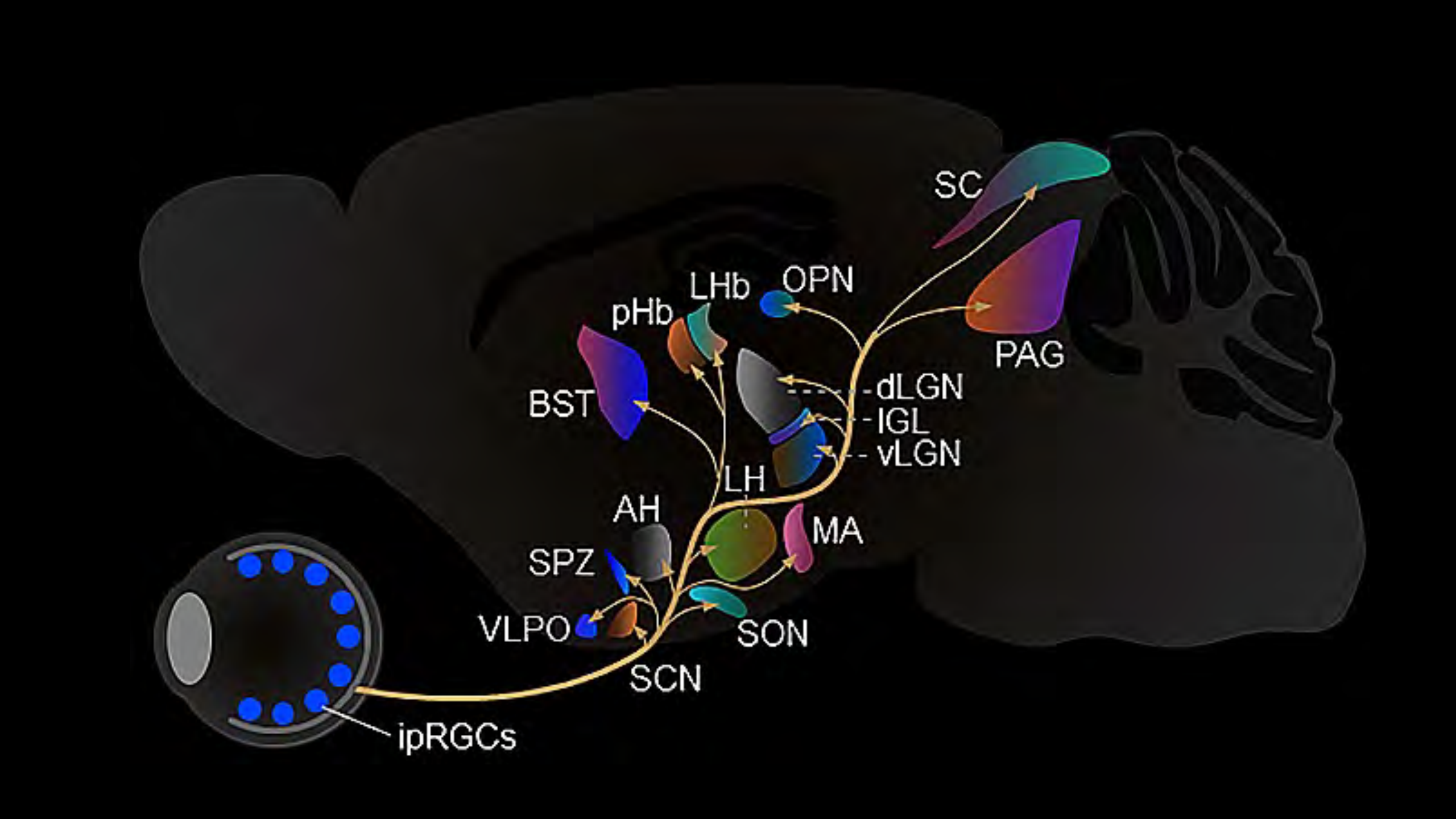
Medulla

Lobula

Lobula Plate


Dorsal stream to
parietal lobe
Primary visual
cortex
Ventral stream to
temporal lobe


VISUAL PATHWAY:
Immature and not active at birth
NON-VISUAL PATHWAY:
Mature and fully active at birth
Thalamus
Hypothalamus
dLGN
Pulvinar
LH
DMH
PVN
EWN
VLPO
sPVZ
OPN
SCN
Pineal
gland
SC
V1
VTA
mAMY
LC


SC
LHb
OPN
pHb
PAG
BST
dLGN
IGL
vLGN
LH
AH
MA
SPZ
VLPO
SON
SCN
ipRGCs

Vertical Light Gradients control behavioural choice in:

- Box jellyfish
- Millipedes
- Moths
- Jumping spiders
- Mice (Rob Lucas, Manchester, UK)

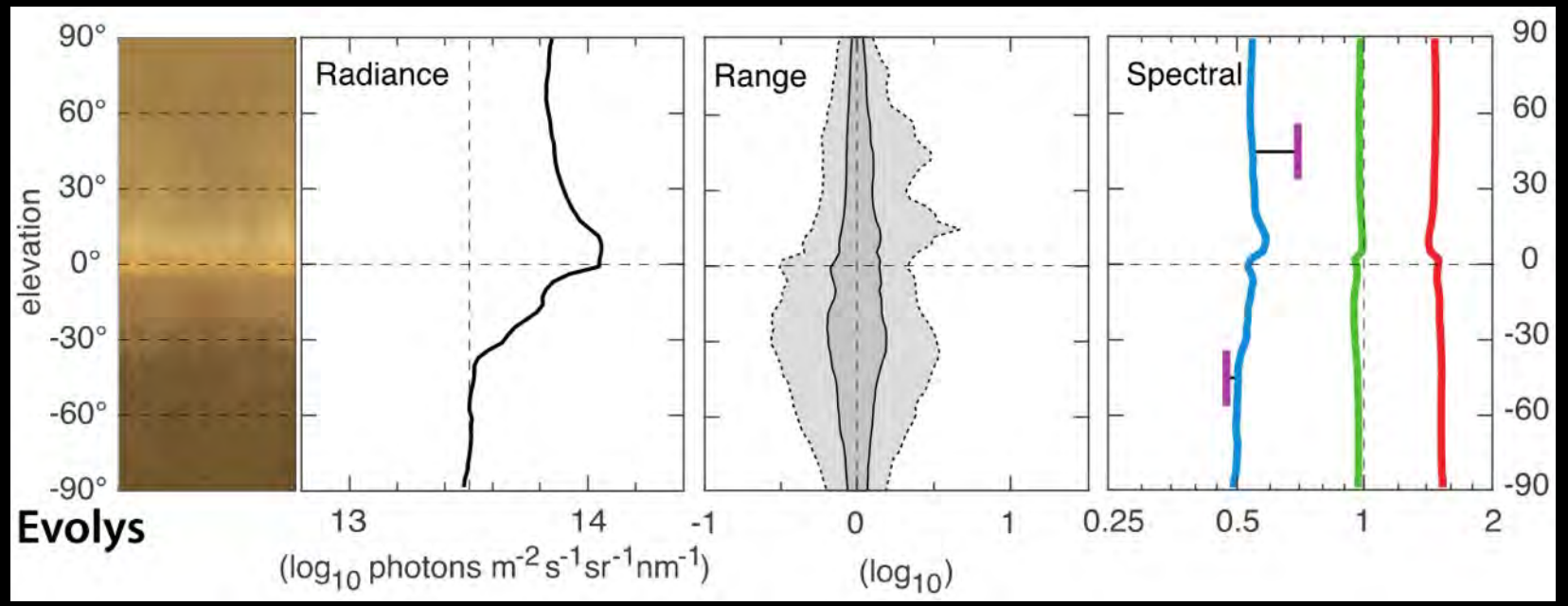
- Generally, in animals and humans alike?

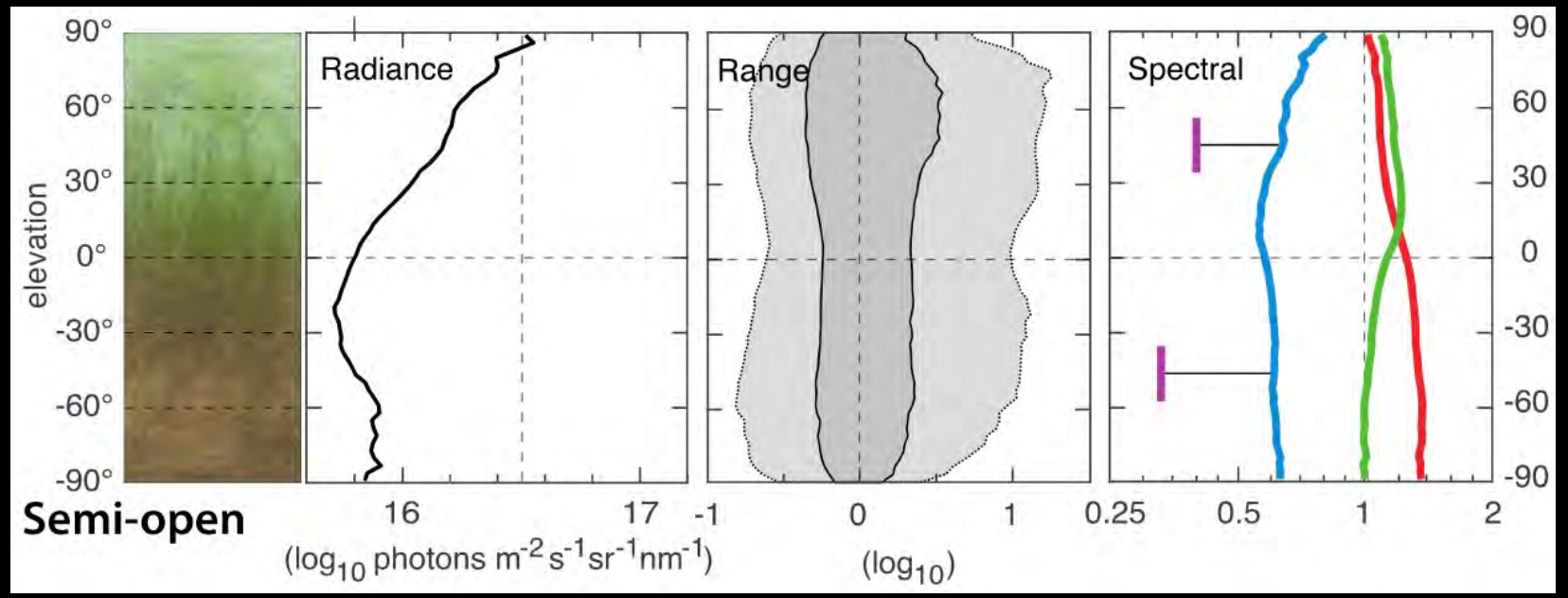
Ecological interactions

Light pollution

Animal husbandry

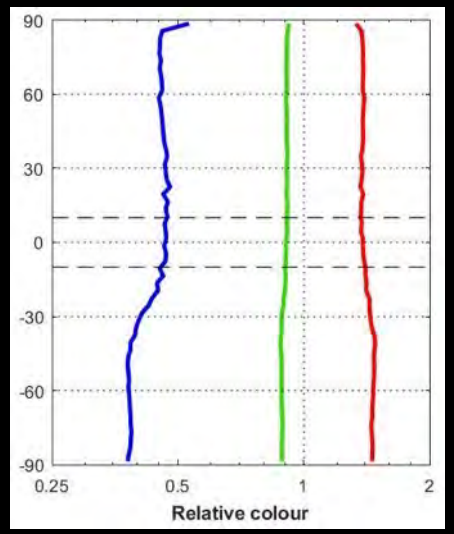
Animal husbandry



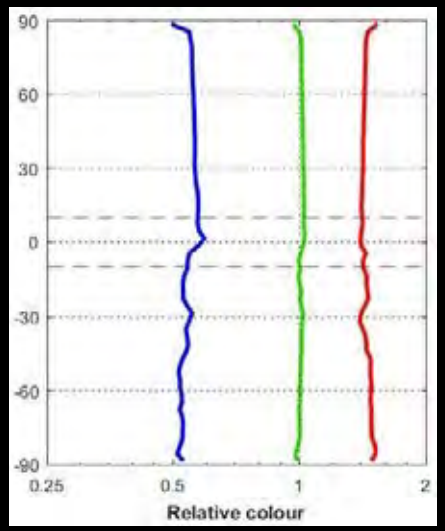


Human lighting....

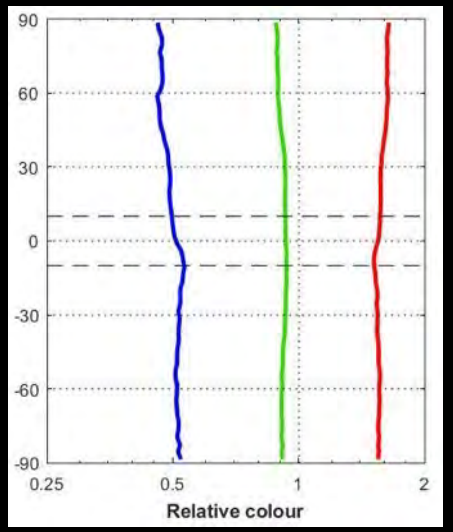
Office



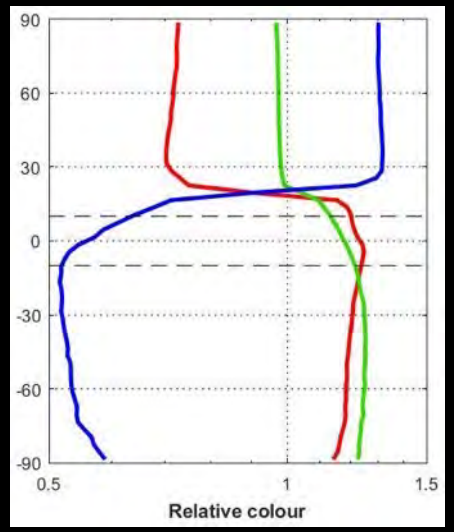
Factory



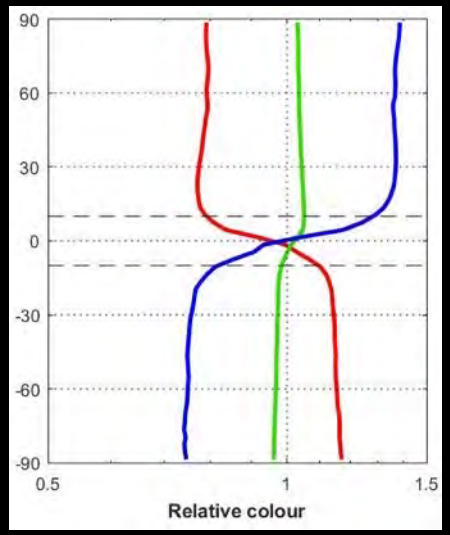
Castle



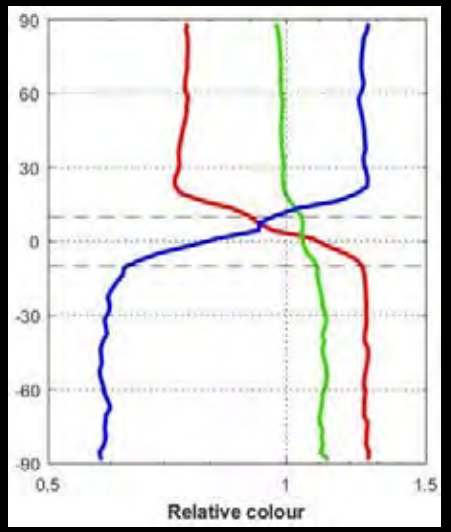
Alpine meadow



Beach dunes



Tenerife garden



Thank you