“My Field For Dummies”: *Conservation Endocrinology – A focus on stress physiology in bats*

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Conservation biology

- Goal-oriented field of science focused on:
  - Determining natural and human-driven impacts on wildlife populations
  - Provide answers to specific questions that can be applied to management decisions
  - Protecting and restoring biodiversity


PACIFIC OCEAN
CANADA
Yellowstone National Park
UNITED STATES
YELLOWSTONE NATIONAL PARK
NATIONAL PARK SERVICE


CPW6
IMPACT
CPW7
IMPACT

What is conservation biology?

- More attention on the organismal biology of individual species
- Physiological responses help predict population declines

Wildlife Conservation Physiology

Taking physiology to the field

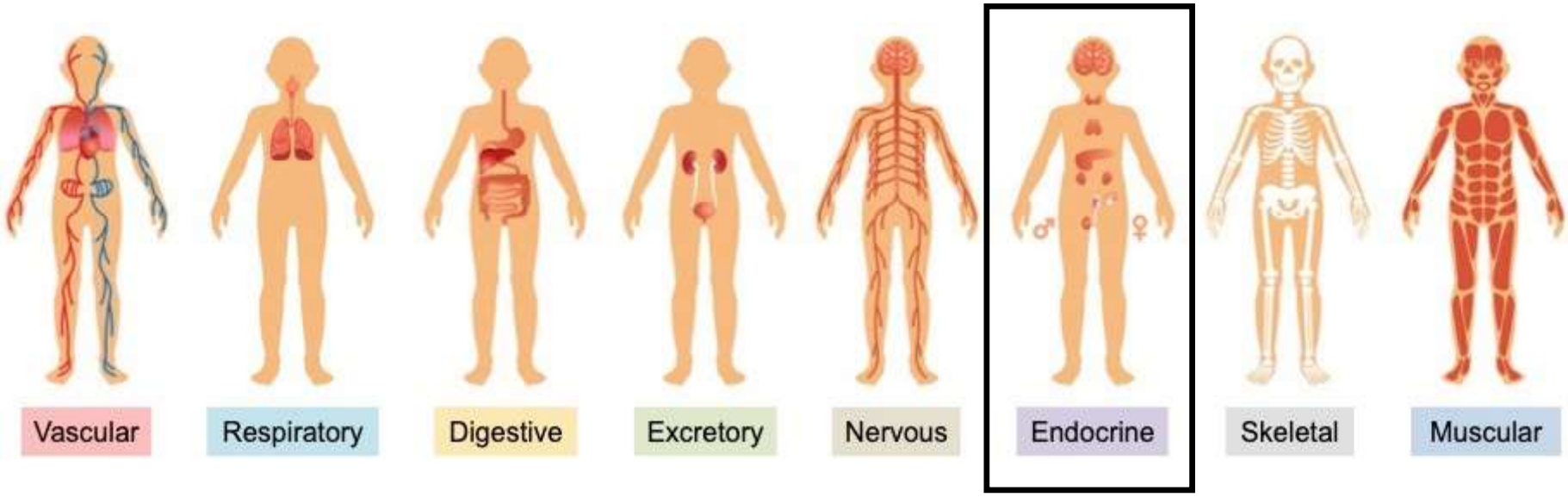
ENVIRONMENTAL MONITORING
biologically relevant scale
microenvironment
biophysical models

INDIVIDUAL RESPONSES
thermal sensitivity
heat production
plasticity and adaptation

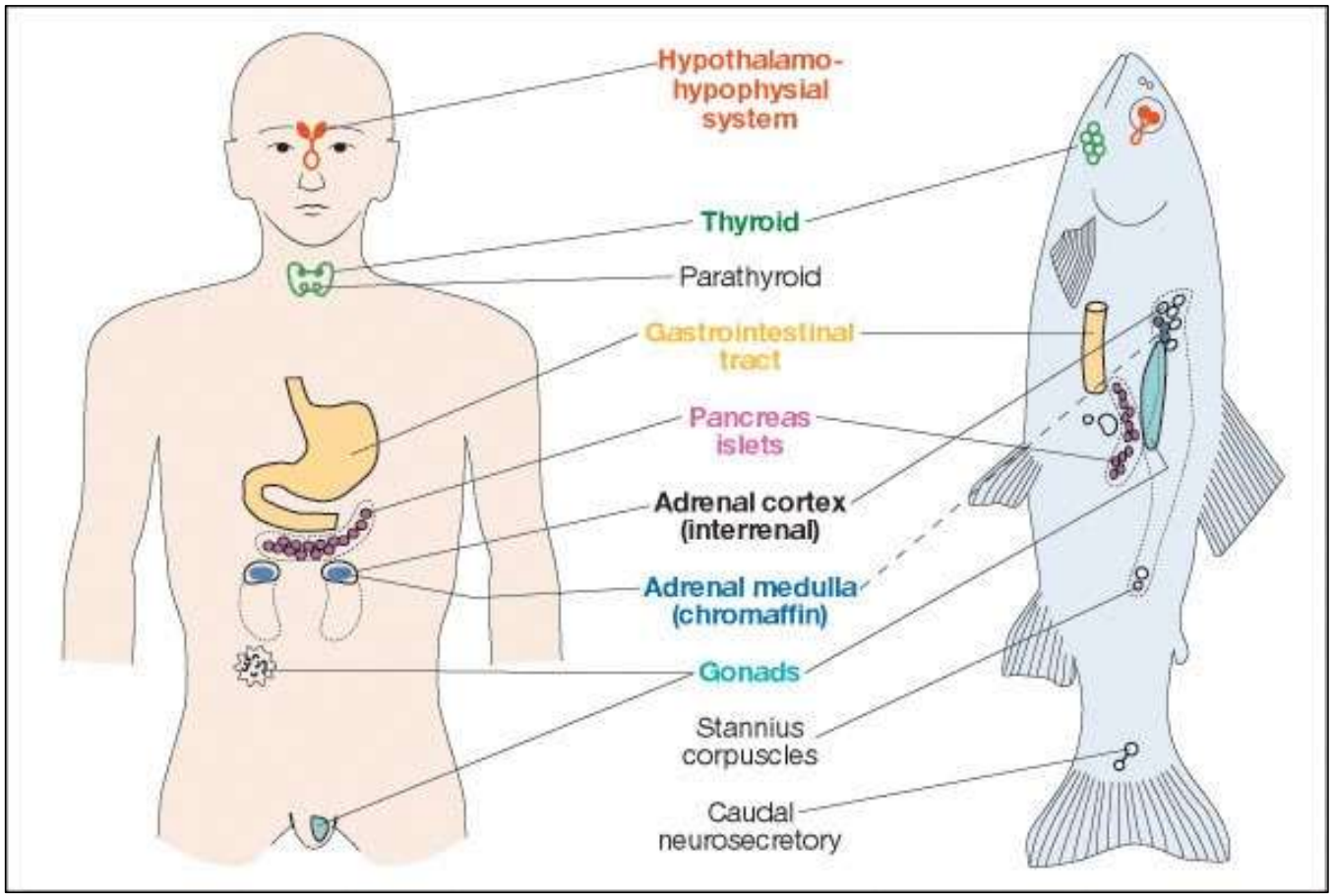
SCALE TO ECOSYSTEMS
species interactions
species distribution models
food-webs

Endocrine System

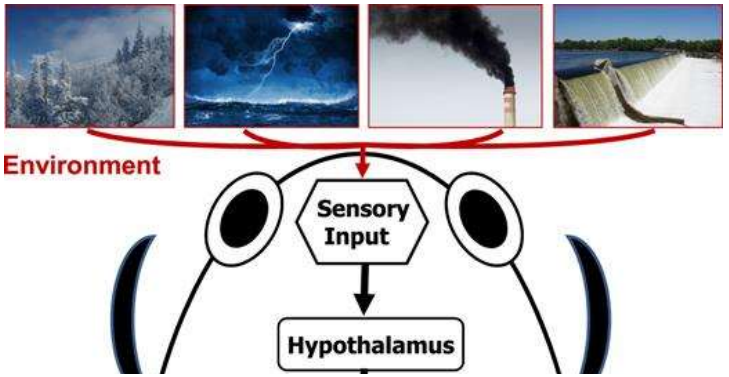
- Chemical bioregulation system composed of specialized tissues (glands, organs) and hormones
- Coordinate development, homeostasis, response to change
- Mediate immune response



Endocrine system is highly conserved



Endocrine System



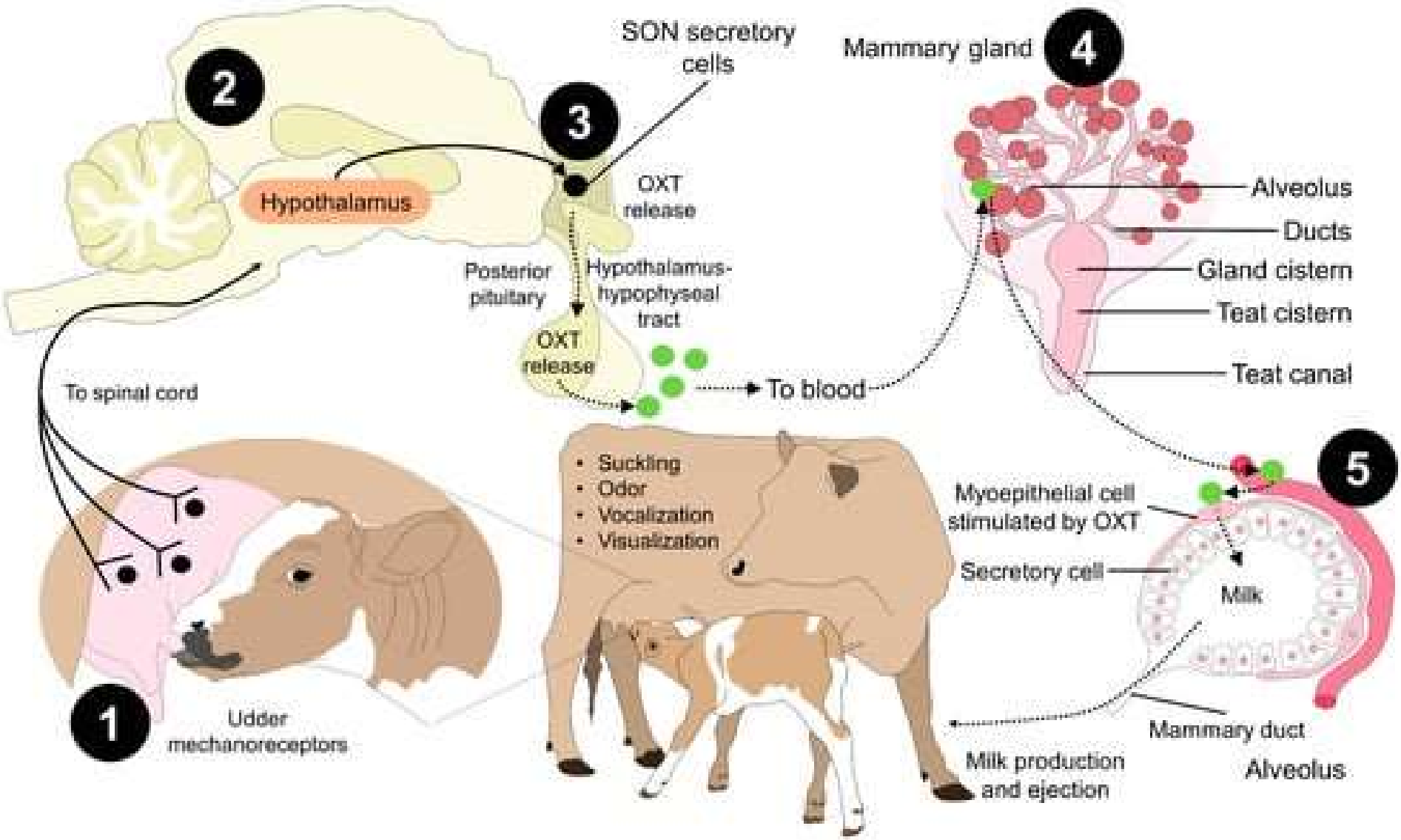
Environmental Stimulus

↓

Endocrine Response

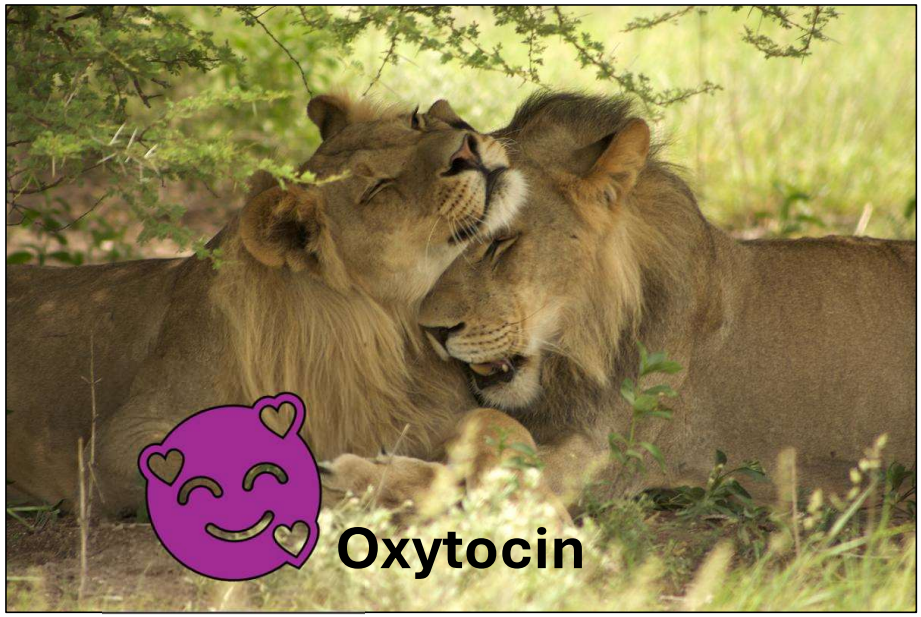
↓

Physiological and/or behavioral change


SON secretory cells
Mammary gland
4
2
3
Hypothalamus
OXT release
Alveolus
Ducts
Gland cistern
Teat cistern
Teat canal
Posterior pituitary
Hypothalamus-hypophyseal tract
OXT release
To spinal cord
To blood
Suckling
Odor
Vocalization
Visualization
5
Myoepithelial cell stimulated by OXT
Secretory cell
Milk
1
Udder mechanoreceptors
Mammary duct
Alveolus
Milk production and ejection

Endocrine System & Conservation

- **Conservation endocrinology** – study of endocrine system to conserve endangered/threatened species
    1. **Determining how** hormones animal survival, growth, reproduction in changing environments
    2. **Implementation** of endocrine monitoring and/or intervention in management



Endocrine System & Conservation

1. **Endocrine Disrupting Compounds**

How do we collect hormone samples?







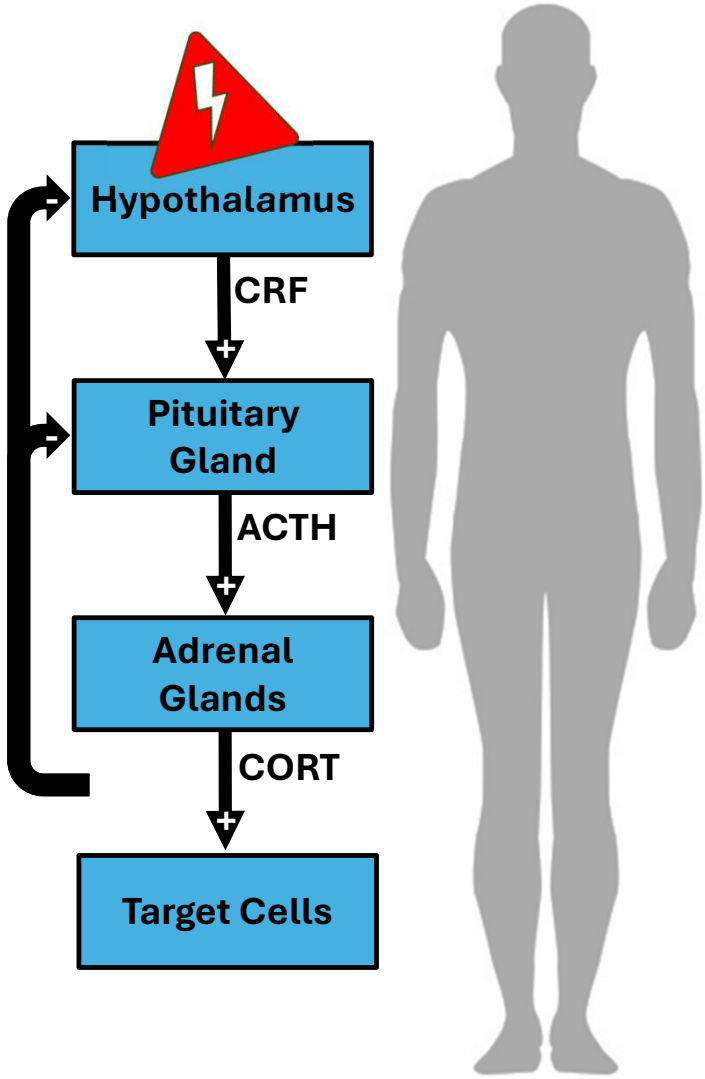

Let’s talk about stress

- Stress-response system is intimately connected with health, fitness
- High levels of stress are often linked with **negative** health impacts

Environment is full of stressors!

Let’s talk about stress

- Glucocorticoids (GCs)
  - “stress hormones”
  - Cortisol (CORT)
  - Corticosterone



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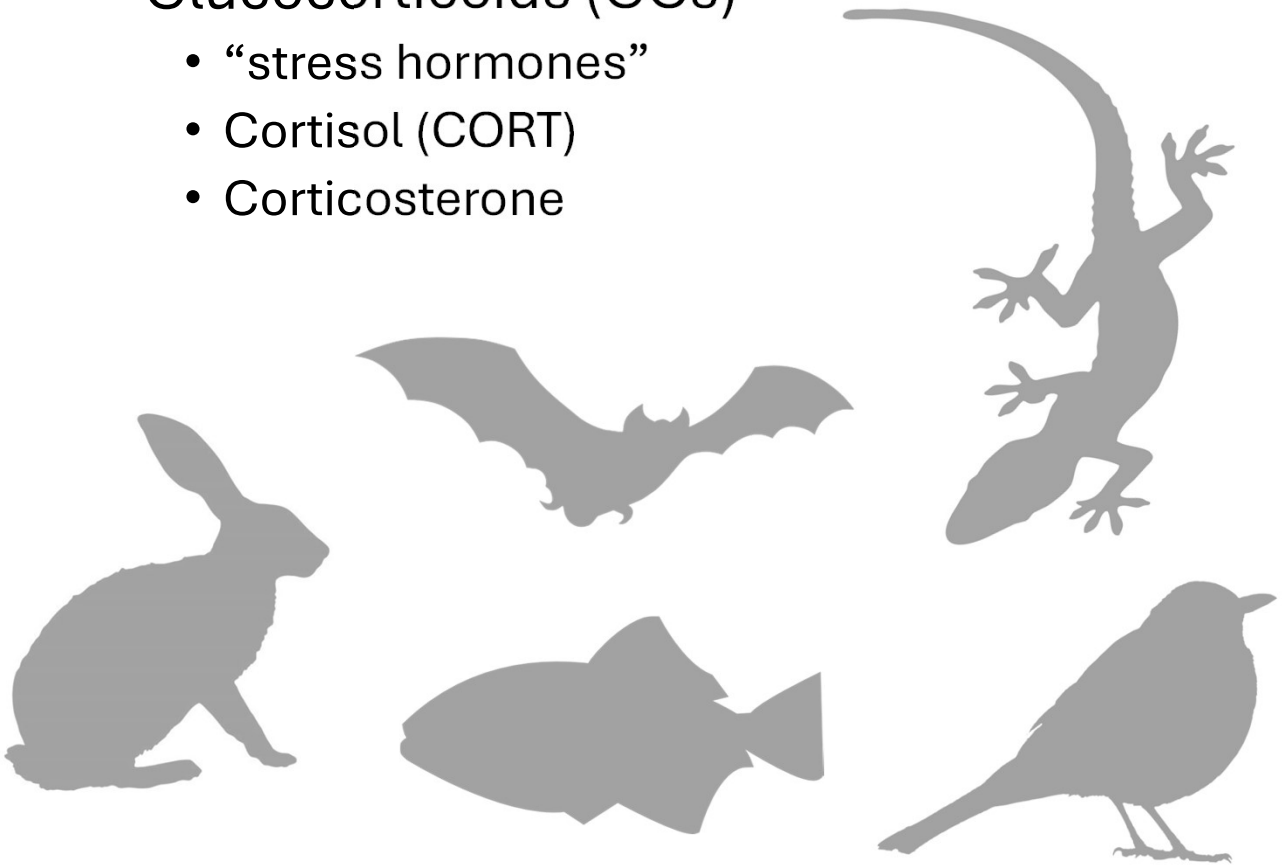

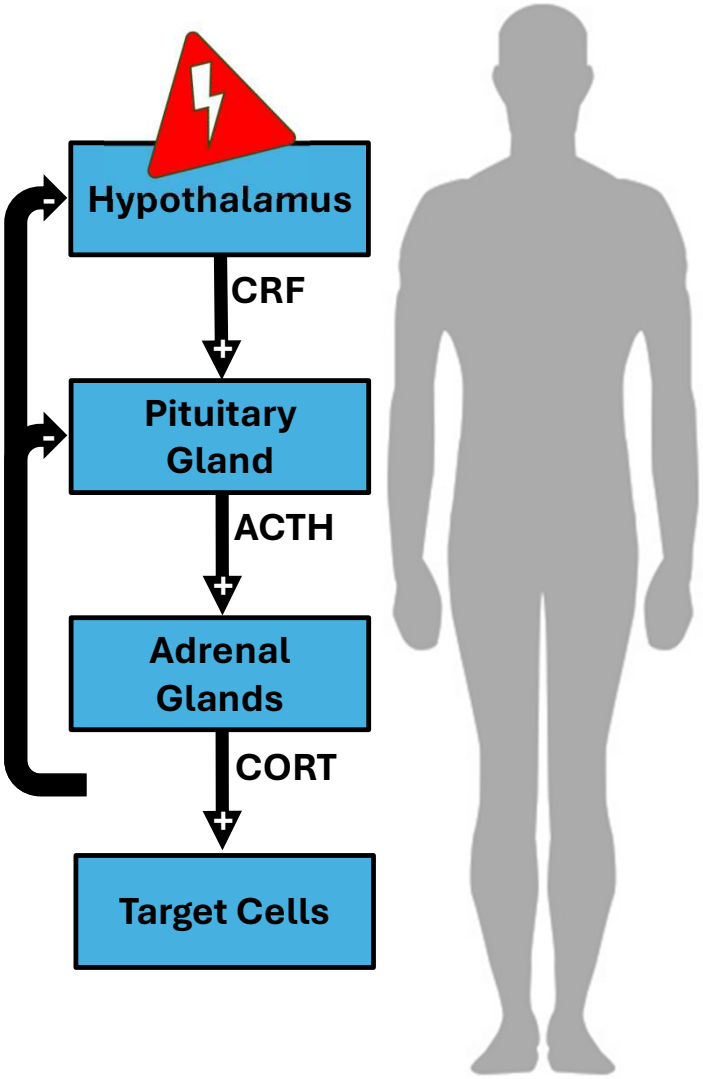

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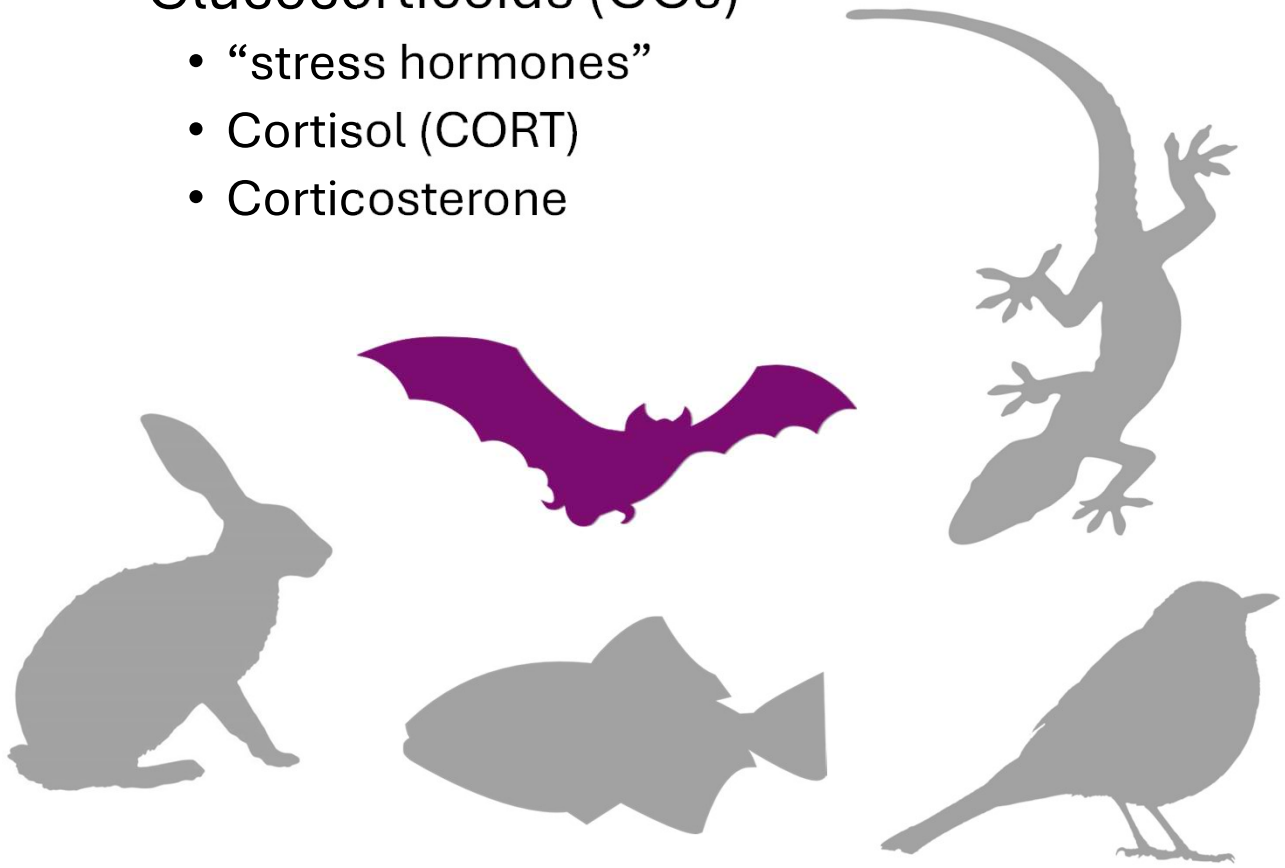
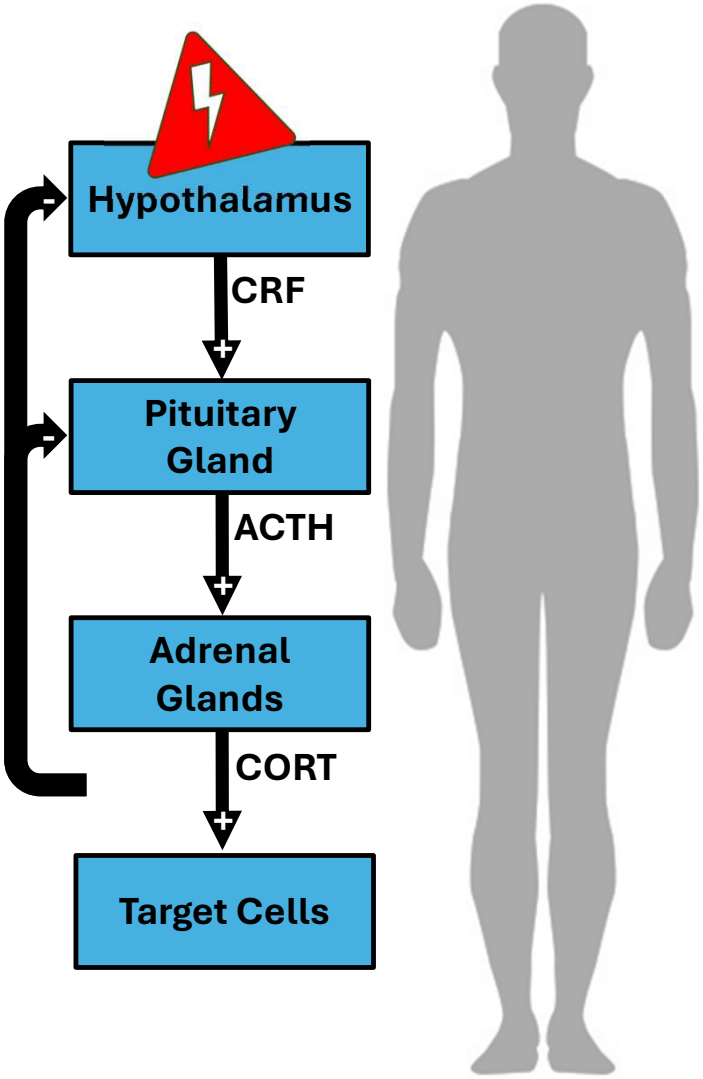
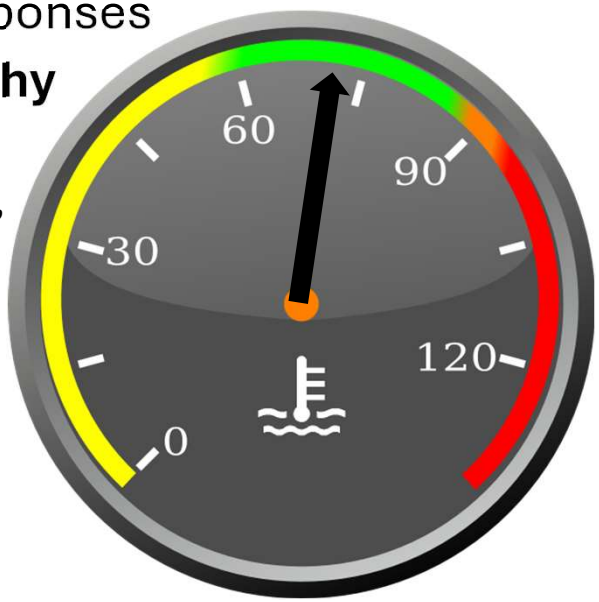


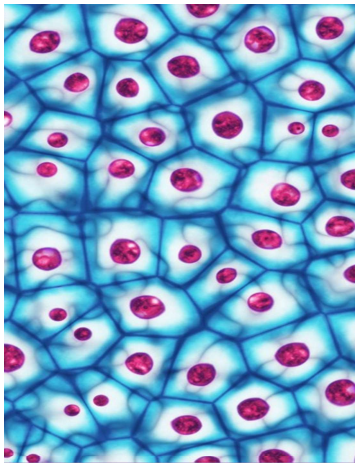


What do GCs do?

- **Functions:**
  - Mediating stress response
  - Maintaining metabolism
  - Immune & inflammatory responses
  - **Basal levels maintain healthy cell functioning**
    - Levels vary (life history events, seasons, circadian rhythms)
- Responds to stressors



GC-o-Meter



Target Cells

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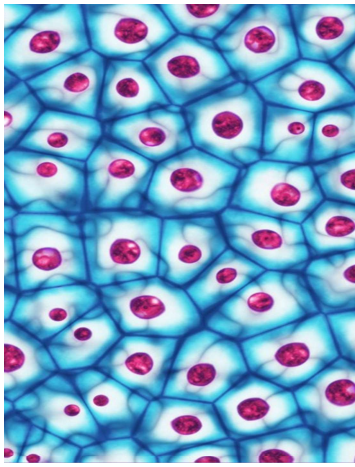

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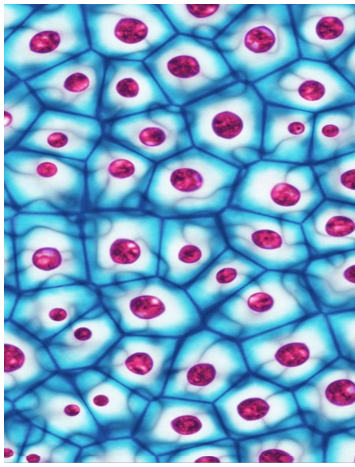

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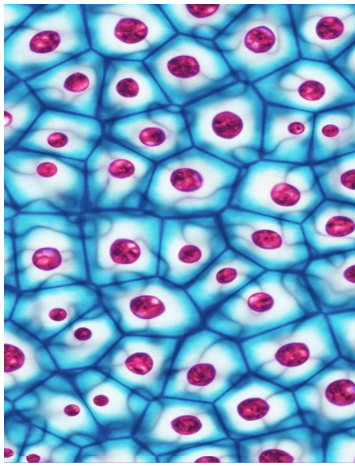
  - **Basal levels maintain healthy cell functioning**
    - Levels vary (life history events, seasons, circadian rhythms)
- Responds to stressors
  - Acute
  - Chronic
    - Consequences – health, fitness

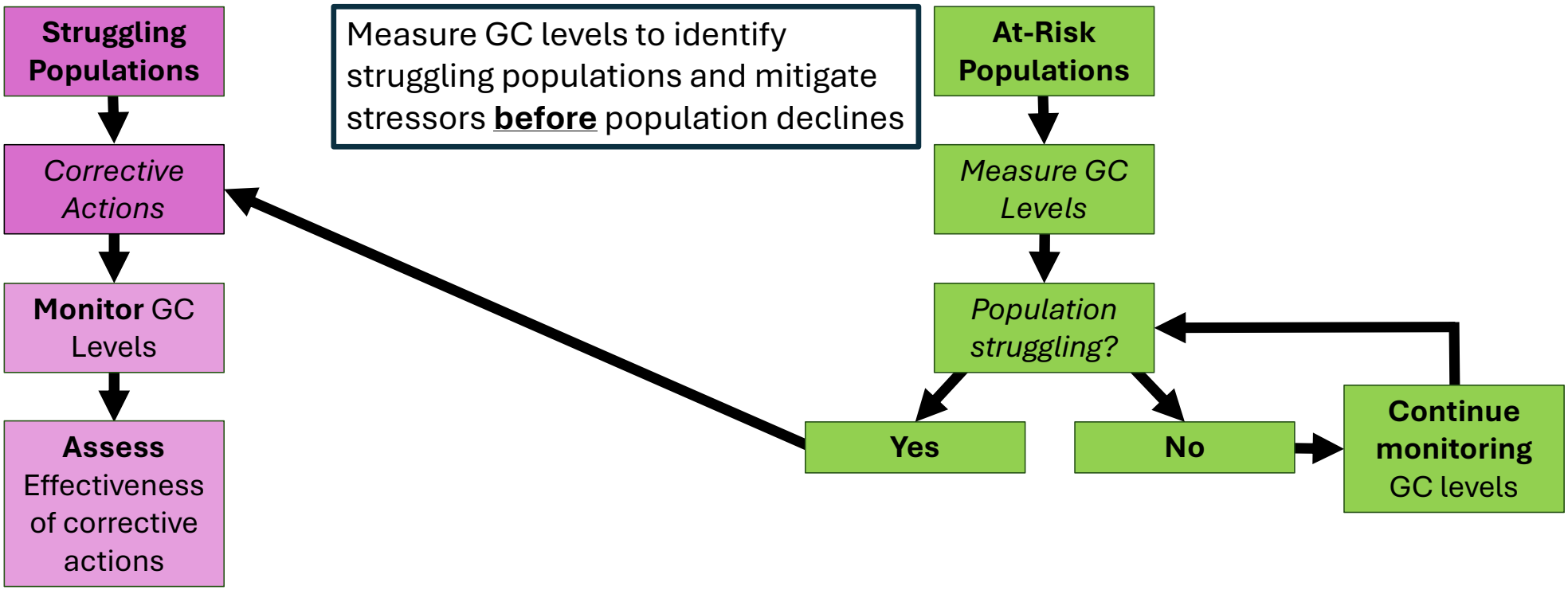
GC-o-Meter



Target Cells

GCs in conservation research

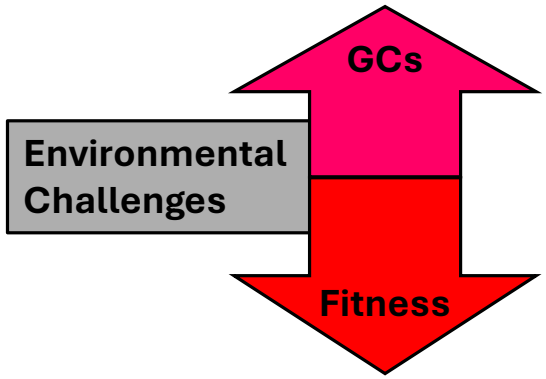
- Problem in conservation – *post hoc* nature of connecting disturbances with population numbers

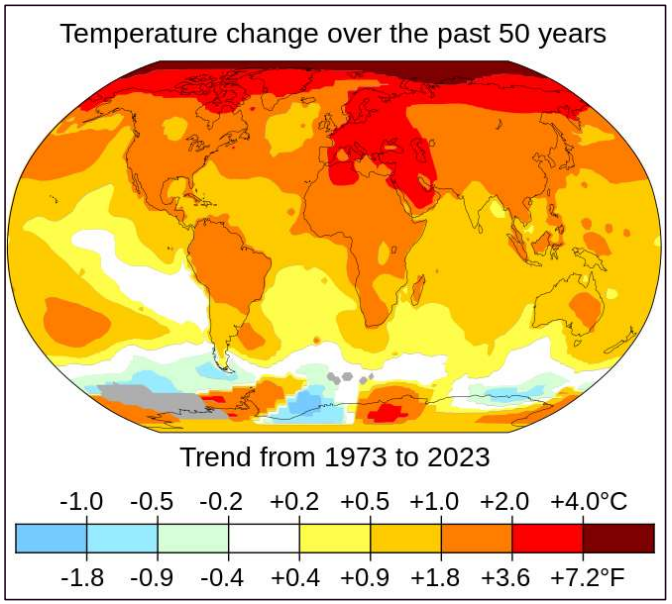


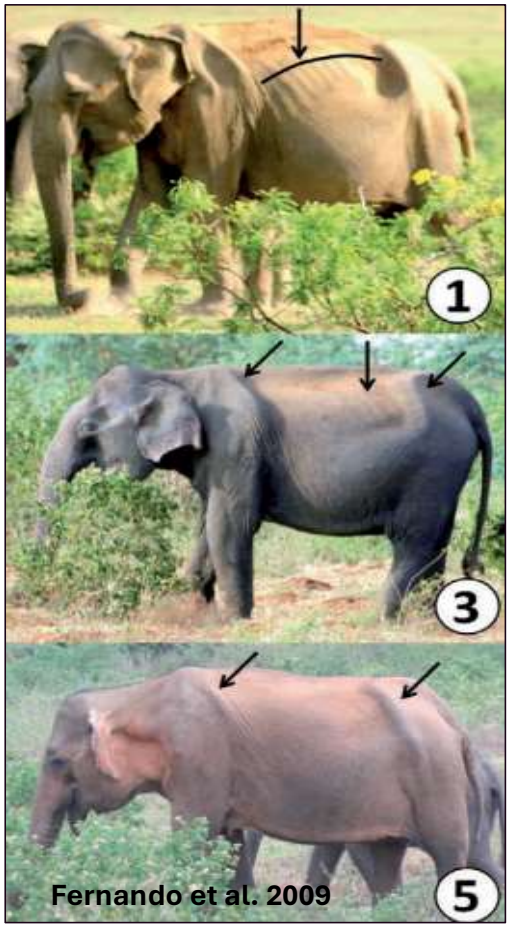
GCs in conservation research

- Predicting population declines using physiological responses

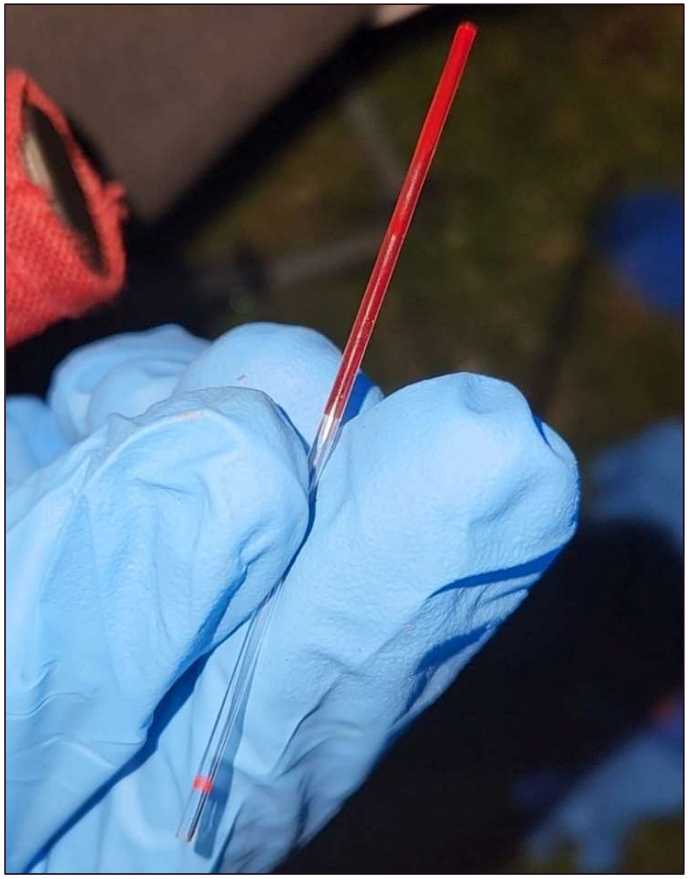
- Cort-Fitness Hypothesis







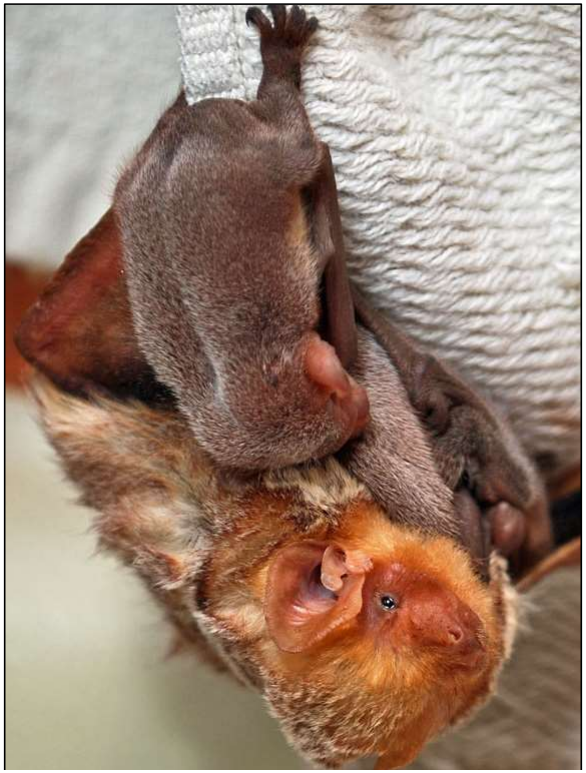
Bats & GCs



Bats & Endocrinology

Conservation?

- Reproduction

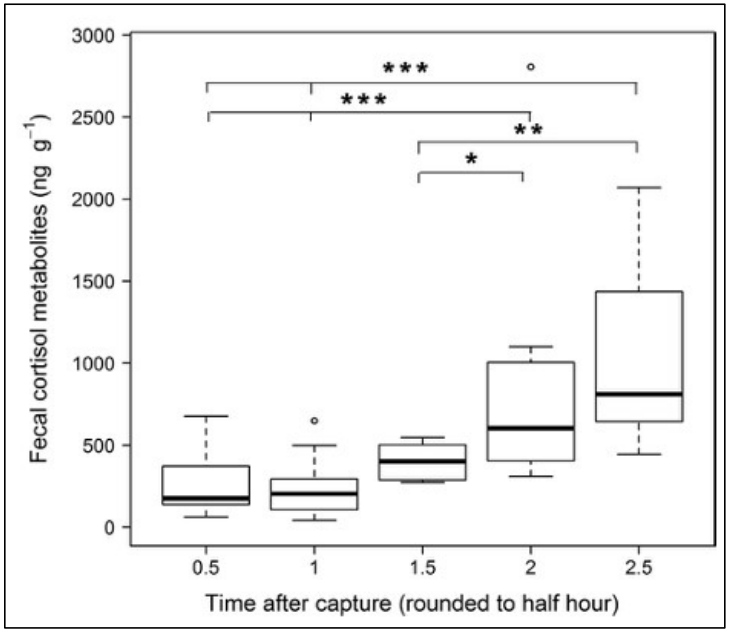


- Digestion

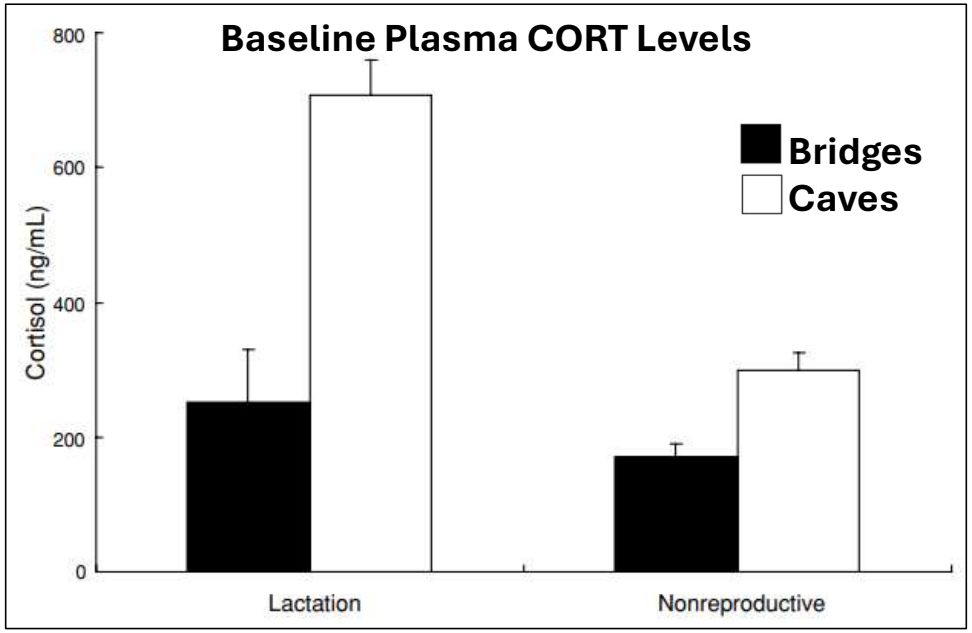
- Winter torpor

Bats & Conservation Endocrinology

- Tropical bats > temperate bats
- Limited studies, mostly baseline
  - Reproduction, Hibernation



Kelm et al. 2016

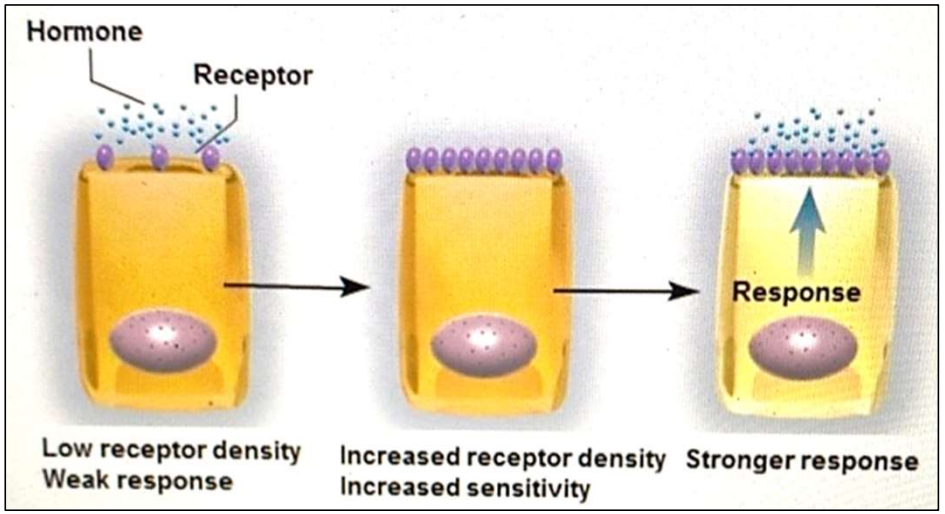


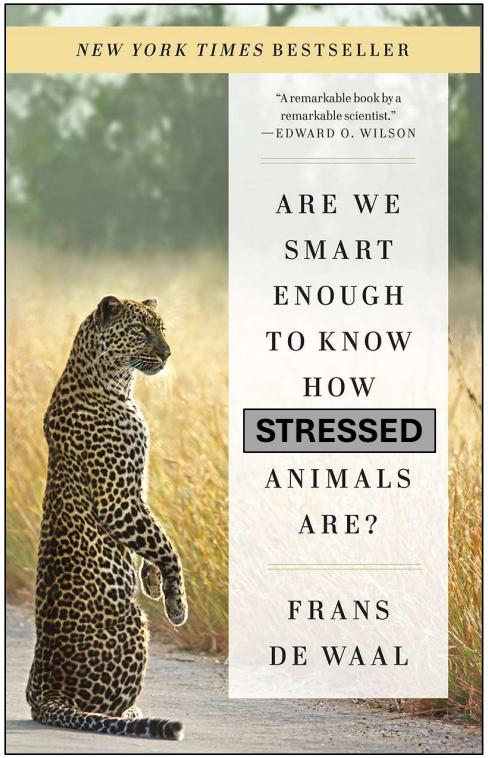
Allen et al. 2010

Limitations of GCs in conservation

GCs as a proxy for individual or group health & fitness is still largely theoretical

1. Habituation to repeated stressors
2. Receptor density & receptor sensitivity
3. Which stressors are perceived as negative?





~~Limitations of GCs in conservation~~

- GC requirements for health maintenance will provide critical information for species and ecosystem conservation
  - Climate change
  - Anthropogenic influences

- Research Needed:
  - Integrate laboratory and field approaches
  - Increase understanding and diagnosing of habituation
  - Species-level research at the individual and group levels

Take-home messages

- Bats are:
  - Necessary for maintaining healthy ecosystems
  - Economically important – agriculture
  - **Under threat** – disease, habitat loss, climate change, etc.

- GCs (& all hormones) are vital for health, fitness
  - Understudied and poorly understood for most bat species
  - Potential new management for bat conservation
  - Enhance efficiency of conservation efforts

QUESTIONS?