Animal Environmental Science

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Contents

Welcome

This is the website for **"Animal environmental science"**. To understanding individual animals, we have to understand the relationship they have with their environment. This book will introduce the interaction between animals and the environment.

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(Snow Monkey Niseko, Kutchan-chō, Japan)

Chapter 1

Introduction

All living creatures constantly interact with the environment. To understanding individual animals, we have to understand the relationship they have with their environment. Basically, animals can find food, shelter, protection, and mates from the environment called **habitat**. The animal habitat includes both phisical (non-living) and biotic (livinig) components (see Table 1.1).

Animal habitat is constantly changed over time. Not only natural disasters (eruption of volcano, earthquake, tsunami, and wildfire), also human activity can affect the animal habitat. Unlike the wildlife, the environment of domesticated animals (such as cow, pig, poultry, and dog) that raised in facility are controlled by the human. Because it's a very huge field, this book can't cover every topic of both wildlife and domesticated animal. Thus, from now on, we will deal with the topic for the domesticated animal.

Table 1.1: Components of habitat (physical and biotic)

Physical	Biotic
Temperature	Plant matter
Humidity	Predators
Oxygen	Parasites
Wind	Competitors
Soil	Individuals of the same species
Light intensity	
Elevation	

Figure 1.1:

Chapter 2

Animal and environment

2.1 External environment

Animal never separates from the stimuli from outside. In the domestic animals, the external environment includes both physical (e.g. housing, feeder, paddock, fence, and noise) and biotic (e.g. human, mate, and feed ingredients) components like those of animal habitat 1.

2.2 Internal environment

> "The living body, though it has need of the surrounding environment, is nevertheless relatively independent of it." — Claude Bernard

Higher animals have complex organ systems that respond to stimuli to perform their essential body functions. When the animal recieves the signals from the sensory organs, they produce a local reflex action and/or react in the central nervous system. Weak signals produce no responses, but strong stimuli changes the physiological or behavioral status of the animal.

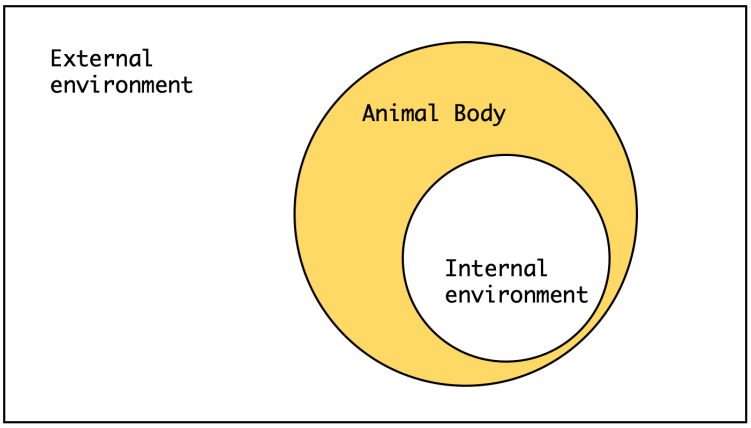

Figure 2.1:

Table 2.1: List of homeostatic control variables

Control variables
Core temperature; Blood glucose; Iron levels; Copper regulation; Levels of blood gases; Blood oxygen content; Arterial blood pressure; Calcium levels; Sodium concentration; Potassium concentration; Fluid balance; Blood pH; Cerebrospinal fluid; Neurotransmission; Neuroendocrine system; Gene regulation; and Energy balance

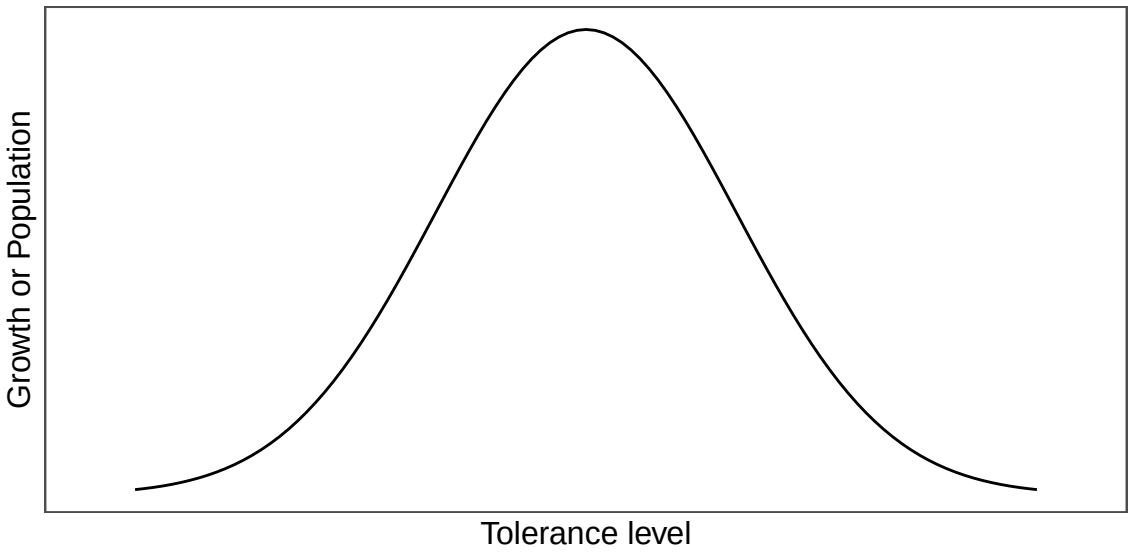

Figure 2.2: Shelford's law of tolerance

2.2.1 Shelford's law of tolerance

> "Each and every species is able to exist and reproduce successfully only within a definite range of environmental conditions." — Ronald Good

Although external environments are continuously changed, if animals in the normal status, they keep the composition of the extracellular fluid (internal environment) constant to maintain their live. We call it *homeostasis*. However, the capacity of to maintain the homeostasis is broken when the animals let the harsh environments, and differ by their species. **Animals may be limited in their growth and their occurrence by the minimum, maximum, and optimum condition** (Shelford, 1931) (Fig. 2.2).

The optimum range of environmental condition may differ within the same organism, and it is not necessarily fixed. They can change as:

- Change of seasons
- Change of environmental conditions
- Life stage of the organism

2.2.2 Adaptation

> "Changes in morphological, anatomical, physiological, biochemical and behavioral characteristics of the animal which promote welfare and favor survival in a specific environment." — Hafez

Hafez et al. (1968) defined an adaptation as above. The adaptation helps an animal survive in their external environment. The representative adaptive traits are:

1. Structural adaptation
2. Behavioural adaptation
3. Physiological adaptation

Structural adaptation is the changes in physical features (e.g. body shape, skin, and internal organs) of the animal. Behavioural adaptation is the changes in behaviours (e.g. searching for food, mating, vocalizations, and mitigation) of the animal. Physiological adaptation is the changes in the animal body functions such as growth, temperature regulation, and ionic balance. Sometimes, adapted animal create a new species (*speciation*).

2.2.3 Acclimatization

Acclimatization is the physiological changes induced by a complex of factors such as altitude, temperature, humidity, photoperiod, or pH. Acclimatization is the short-term process (hours to weeks) by comparison with adaptation (take place over many generations).

Part I

Environmental effects on animals

Chapter 3

Temperature

All chemical reactions are affected by temperature. Especially,

3.1 Poikilotherm and homoiotherm

3.2 Thermoregulation

3.3 Temperature humadity index (THI)

3.4 Effects on production

3.4.1 Dairy cattle

3.4.2 Beef cattle

3.4.3 Swine

3.4.4 Poultry

(Isfahan Province, Aran o Bidgol, Iran)

Chapter 4

Light

4.1 Photoperiodic response

4.2 Effects on productivity

4.2.1 Wool

4.2.2 Feathers

4.2.3 Antlers

4.2.4 Puberty

4.2.5 Reproduction

4.2.6 Behavior

4.2.7 Light control in poultry production

Chapter 5

Sound

Chapter 6

Air quality

Chapter 7

Water quality

Part II

Animal effects on the environment

Chapter 8

Cycles of materials

8.1 Ecosystem

8.2 Trophic level

8.3 Carbon cycle

8.4 Nitrogen cycle

8.5 P and Ca cycle

Chapter 9

Manure

9.1 Charateristics of animal manure

9.2 Manure treatment

9.2.1 Composting

9.2.2 Liquid fertilizer

9.2.3 Purification

9.2.4 Energy generation

9.2.5 Animal feed

Chapter 10

Greenhouse gases

Here is a review of existing methods.

Part III

Sustainable livestock industry

Chapter 11

Animal welfare

Here is a review of existing methods.

Chapter 12

Sustainable livestock industry

"In essence, the conflict between livestock and the environment is a conflict between different human needs and expectations." — Henning Steinfeld (FAO)

Bibliography

Hafez, E. S. E. et al. (1968). Adaptation of domestic animals. *Adaptation of domestic animals.*

Shelford, V. E. (1931). Some concepts of bioecology. ISBN 1939-9170.