

THE BIOLOGY AND MANAGEMENT OF WILD RUMINANTS

CHAPTER SIX

SYSTEMS PHYSIOLOGY

by

Aaron N. Moen

Professor of Wildlife Ecology

Department of Natural Resources

College of Agriculture and Life Sciences

Cornell University

Ithaca, N.Y. 14853

and

Certified Wildlife Biologist

(The Wildlife Society)

Published by

CornerBrook Press

Box 106

Lansing, N.Y. 14882

Copyright © 1981 by Aaron N. Moen

No part of this book may be reproduced by any mechanical, photographic or electronic process, or in the form of a phonograph recording, nor may it be stored in a retrieval system, transmitted, or otherwise copied for public or private use without written permission of Aaron N. Moen

Library of Congress Catalog Card Number 80-70984

## CONTENTS OF CHAPTER SIX

### SYSTEMS PHYSIOLOGY

TOPIC 1. GASTROINTESTINAL SYSTEM FUNCTIONS . . . . .	3
UNIT 1.1: MECHANICAL FUNCTIONS . . . . .	7
UNIT 1.1: REFERENCES . . . . .	9
UNIT 1.2: FERMENTATION AND DIGESTION . . . . .	11
UNIT 1.2: REFERENCES . . . . .	13
UNIT 1.3: PRODUCTS OF FERMENTATION . . . . .	17
UNIT 1.3: REFERENCES . . . . .	20
TOPIC 2. CARDIOVASCULAR SYSTEM FUNCTIONS . . . . .	25
UNIT 2.1: HEART RATES . . . . .	27
UNIT 2.1: REFERENCES . . . . .	30
UNIT 2.2: STROKE VOLUME . . . . .	33
UNIT 2.2: REFERENCES . . . . .	34
UNIT 2.3: BLOOD VOLUMES . . . . .	37
UNIT 2.3: REFERENCES . . . . .	37
UNIT 2.4: BLOOD CHARACTERISTICS . . . . .	41
UNIT 2.4: REFERENCES . . . . .	43
TOPIC 3. RESPIRATORY SYSTEM FUNCTIONS . . . . .	49
UNIT 3.1: EXTERNAL RESPIRATION . . . . .	49
UNIT 3.1: REFERENCES . . . . .	50
UNIT 3.2: INTERNAL RESPIRATION . . . . .	53
UNIT 3.2: REFERENCES . . . . .	53
TOPIC 4. REPRODUCTIVE SYSTEM FUNCTIONS . . . . .	55
UNIT 4.1: REPRODUCTIVE CYCLES . . . . .	57
UNIT 4.1: REFERENCES . . . . .	58
UNIT 4.2: SPERMATOGENESIS AND OVULATION . . . . .	63
UNIT 4.2: REFERENCES . . . . .	64
UNIT 4.3: GESTATION AND PARTURITION . . . . .	69
UNIT 4.3: REFERENCES . . . . .	69
UNIT 4.4: LACTATION . . . . .	73
UNIT 4.4: REFERENCES . . . . .	74
TOPIC 5. EXCRETORY SYSTEM FUNCTIONS . . . . .	77
UNIT 5.1: URINARY FUNCTIONS . . . . .	77
UNIT 5.1: REFERENCES . . . . .	79
UNIT 5.2: FECAL FUNCTIONS . . . . .	81
UNIT 5.2: REFERENCES . . . . .	81
TOPIC 6. SKELETAL SYSTEM FUNCTIONS . . . . .	85
UNIT 6.1: THE SKELETON AS SUPPORT . . . . .	85
UNIT 6.1: REFERENCES . . . . .	85
UNIT 6.2: THE SKELETON AS A STORAGE RESERVOIR . . . . .	89
UNIT 6.2: REFERENCES . . . . .	89

TOPIC 7. MUSCULAR SYSTEM FUNCTIONS . . . . .	93
UNIT 7.1: LOCOMOTION . . . . .	93
UNIT 7.1: REFERENCES . . . . .	94
UNIT 7.2: THERMOGENESIS . . . . .	97
UNIT 7.2: REFERENCES . . . . .	98
UNIT 7.3 INVOLUNTARY MUSCULAR CONTRACTIONS . . . . .	101
UNIT 7.3: REFERENCES . . . . .	101
TOPIC 8. NERVOUS SYSTEM FUNCTIONS . . . . .	103
UNIT 8.1: VISION . . . . .	105
UNIT 8.1: REFERENCES . . . . .	105
UNIT 8.2: HEARING . . . . .	107
UNIT 8.2: REFERENCES . . . . .	108
UNIT 8.3: OLFACTION . . . . .	111
UNIT 8.3: REFERENCES . . . . .	112
UNIT 8.4: TASTE . . . . .	115
UNIT 8.4: REFERENCES . . . . .	115
UNIT 8.5: TOUCH . . . . .	119
UNIT 8.5: REFERENCES . . . . .	119
UNIT 8.6: THERMAL SENSES . . . . .	121
UNIT 8.6: REFERENCES . . . . .	121
CLOSING COMMENTS . . . . .	123
GLOSSARY OF SYMBOLS USED . . . . .	125
GLOSSARY OF CODENS . . . . .	127
LIST OF PUBLISHERS . . . . .	131
LIST OF WORKSHEETS . . . . .	133

## CHAPTER 6. SYSTEMS PHYSIOLOGY

Animals are complex biochemical entities, with specialized organs that perform particular functions. Organs have functional relationships with other body parts, and those with related functions are grouped together as systems.

The physiological functions of the systems of wild ruminants have not been studied very thoroughly. This is understandable because of the costs and difficulties involved. Their importance, however, is great, since physiological functions encompass all of the biochemistry of life. They have been given considerable attention by domestic animal scientists, and Duke's Physiology of Domestic Animals (Swenson 1970) is a classic text on this general subject.

A number of vital signs, including heart rates, respiration rates, and body temperatures are considered in this chapter. Signs indicate the status of the functions of some rather important body systems. Many of the functions are of direct importance to two or more systems. Cardiovascular and respiratory functions are interrelated, and these interact with the products of gastrointestinal functions. They also indicate the presence of internal responses that are not always accompanied by overt behavioral responses. Heart rates, for example, may accelerate as a fright response, even though the animal may not run away.

Vital signs also show diurnal and seasonal variations. Heart rates of deer, for example, are reduced when an animal is at rest each day, a short-term energy conservation adaptation, and they are reduced in winter when deer are less active, a long-term and very important energy conservation adaptation.

The organization of CHAPTER 6 is based on commonly-recognized systems of the body. The TOPICS describing the functions of each system are presented in the same order as the UNITS in CHAPTER 1 which contained descriptions of system characteristics.

### LITERATURE CITED

- Swenson, M. J., Ed. 1970. Dukes's physiology of domestic animals. Comstock Publishing Co., Cornell University, Ithaca, NY. 1463 pp.

# REFERENCES, CHAPTER 6

## SYSTEMS PHYSIOLOGY

### BOOKS

TYPE	PUBL	CITY	PGES	ANIM	KEY WORDS-----	AUTHORS/EDITORS--	YEAR
aubo	mhbc	nyny	895		a textbook of genl physiol	mittchell,ph	1956
aubo	jwwa	pome	194		introduc to mammal biology	avis,fr	1957
aubo	uchp	chil	642		basic physiology	d'amour,fe	1961
aubo	moco	salo	547		textbook of physiology	tuttle,ww; schott	1961
aubo	haro	nyny	619		genl physiol, molec apprch	dowben,rm	1969
aubo	wiwi	bama	1964		textbk genl physio, 4th ed	davson,h	1970
aubo	hrwi	nyny	231		structu and functn, 2nd ed	griffin;;dr; novi	1970
edbo	coup	itny	1463		duke's physiol of dom anim	swenson,mj,ed	1970
edbo	lefe	phpa	573		textbook of veterin physio	breazile,je,ed	1971
aubo	saco	phpa	422		vertebrate physiology	mccauley,wj	1971
aubo	vare	nyny	691		principles of physiology	hartenstein,r	1972
aubo	edar	loen	342		princ anim physiol, 2nd ed	wood,dw	1974
aubo	hein	loen	660		biology of mammals, 4th ed	clegg,pc; clegg,a	1975
aubo	grst	nyny			intro to physiolog, 5 vols	davson,h; segal,m	1975
aubo	prha	ecnj	848		gen & comp physiol, 2nd ed	hoar,ws	1975
aubo	haro	nyny	656		comp phy of anim, env appr	hill,rw	1976
aubo	hrwi	nyny	533		intro to comparatv physiol	goldstein,l	1977
aubo	macm	nyny	699		phys, princ, adapt, 3rd ed	gordon,ms	1977
aubo	whfr	sfca	558		animal physiology	eckert,r; randall	1978
aubo	cupr	nyny	560		phys, adapt, enviro, 2nd ed	schmidt-nielsen,k	1979
aubo	macm	nyny	891		princ anim physiol, 2nd ed	wilson,ja	1979