TOPIC 2. WATER METABOLISM

Water is not only an important but the major component of the body of ruminant animals. It is not the water as a compound composed of hydrogen and oxygen that is of significance, however, but rather its properties that allow the many physical-chemical processes to occur.

The water content of fetuses is very high--90% or more--and declines with advancing gestation. Adult cattle, however, still have water contents of 40 to 70% or more, and white-tailed deer have water contents of 60% of ingesta-free adult body weight (Robbins et al. 1974).

Body composition data given in CHAPTER 2 show that water and fat fractions are inversely proportional. This is because the water content of fat is only about 10% or less. Thus fat animals, such as wild ruminants in the fall at maximum weights during the annual cycle, have a lower water fraction than lean ones.

Water molecules can rapidly penetrate most cell membranes (Houpt 1970:745). If a pressure gradient exists, then water molecules are expected to move from the higher pressure to the lower pressure. The same should occur if there are differences in osmotic concentrations; water should move from the lower concentration to the higher one. Since water molecules are often more likely to penetrate through membranes than solute molecules, concentration differences may be equalized by the movement of water.

LITERATURE CITED

Houpt, T. R. 1970. Water, electrolytes and acid-base balance. Pages 743-766 In M. J. Swenson, Ed. Dukes' physiology of domestic animals. 8th Ed. Cornell University Press, Ithaca, N. Y. 1463 pp.

Robbins, C. T., A. N. Moen and J. T. Reid. 1974. Body composition of white-tailed deer. J. Anim. Science 38(4):871-876.

REFERENCES, TOPIC 2

WATER METABOLISM

BOOKS

TYPE	PUBL	CITY	PGES	ANIM	KEY WORDS----------	AUTHORS/EDITORS--	YEAR
edbo	nyha	nyny	255		symp on salt & water metab	fishman,ap,ed	1960
edbo	else	nyny	251		wat, elctrolyt met, 2nd ed	de graeff,j,ed; 1	1964
edbo	macm	nyny	570		symp, thirst, reg body wat	wayner,mj,ed	1964
aubo	moco	salo	169		wat, elect met, acd-ba bal	muntwyler,e	1968
edbo	base	nyny	260		n, electro, wat & ener met	rechcigl,m,jr ed	1970

OTHER PUBLICATIONS

Johnson, C. E. 1940. Waterholes for wildlife. National Park Service, Region Three Quart. 2(2):9-11.

Smith, A. D. 1954. How much water does a deer drink? Utah Fish & Game Bulletin 10(9):1,8.

Talbot, M. W. 1926. Range watering places in the southwest. U. S. Department of Agriculture Department Bulletin No. 1358. pp. 1-43.

UNIT 2.1: WATER COMPARTMENTS

Body water may be divided into two compartments: intracellular and extracellular. These terms refer to the fluid inside the cells and outside the cells, respectively. Extracellular fluid is further divided into interstitial fluid and plasma (Houpt 1970:744). The plasma is part of the vascular system, of course, and interstitial fluid is within tissues but not in cells.

LITERATURE CITED

Houpt, T. R. 1970. Water, electrolytes, and acid-base balance. pp. 743-766 In M. J. Swenson, Ed. Dukes' physiology of domestic animals. 8th Ed. Cornell University Press, Ithaca, N. Y. 1463 pp.

REFERENCES, UNIT 2.1

WATER COMPARTMENTS

SERIALS

CODEN VO-NU BEPA ENPA ANIM KEY WORDS---------- AUTHORS---------- YEAR

odvi

CODEN VO-NU BEPA ENPA ANIM KEY WORDS---------- AUTHORS---------- YEAR

odhe

CODEN VO-NU BEPA ENPA ANIM KEY WORDS---------- AUTHORS---------- YEAR

ceel

CODEN VO-NU BEPA ENPA ANIM KEY WORDS---------- AUTHORS---------- YEAR

alal

CODEN VO-NU BEPA ENPA ANIM KEY WORDS---------- AUTHORS---------- YEAR

CJZOA 50--1 107 116 rata chang body water extracell cameron,rd; luick 1972

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
JWMAA	34--4	908	912	anam	energ flux, water kinetics	wesley,de; knox,/	1970
XIBPA	1....	250	250	anam	water kinetics in pronghor	wesley,de; knox,/	1971

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
				bibi			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
				ovca			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
				ovda			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
				obmo			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
				oram			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
PNUSA	16--2	108	112		functions of water in body	robinson,jr	1957
SZSLA	31---	261	296	mamm	comprtv watr & energ econo	macfarlane,wv; ho	1972

UNIT 2.2: REQUIREMENTS AND TURNOVER RATES

The water balance is obviously an important part of the physiology of wild ruminants since water is such a major component of animal tissue. Water consumption is very difficult to determine, however, because the sources of water include forage (often 50% or more water), dew on the vegetation (sometimes twice a day), snow (often present in large quantities), and open water. A unique experimental set-up is described by Elder (1954) who was able to measure the water consumption of individuals and groups of mule deer that drank from tubs and barrels in which water levels could be measured. Six to seven quarts were consumed in an average of three minutes of drinking time.

Wild ruminants are not as dependent on open water as domestic ones are. Many species do not seem to frequent open water at all, except perhaps in the heat of summer when water losses are high. The vegetation and snow seem to be adequate sources under most natural conditions. Nevertheless, white-tailed deer, a species that can get along well in a frozen habitat, will use open water when available. There are reports in published literature of a lack of interest in open water (see Hosley 1956), yet whitetails do use open water in otherwise frozen habitat. I have observed large amounts of deer activity in a seeepage area below an earth dam in west-central Minnesota, and in natural seepage areas at Cornell's Arnot Forest in New York State.

It is difficult to separate requirements from preferences. Water requirements are met in several different ways; preferences for meeting those water requirements vary through the year and from place to place. The water consumption of pronghorn varied inversely with the quantity and succulence of the preferred forage species (Beale and Smith 1970). Succulent spring vegetation has a high water content and excess water is excreted not only in urine but also in feces.

References on water consumption follow. The WORKSHEET is included which relates to forage intake calculations and the water content of the forage.

LITERATURE CITED

Beale, D. M. and A. D. Smith. 1970. Forage use, water consumption, and productivity of pronghorn antelope in western Utah. J. Wildl. Manage. 34(3):570-582.

Elder, J. B. 1957. Notes on summer water consumption by desert mule deer. J. Wildl. Manage. 18(4):540-541.

Hosley, N. W. 1956. Management of white-tailed deer in its environment. Pages 187-259 In W. P. Taylor, Ed., The Deer of North America. The Stackpole Company. Harrisburg, PA 668 pp.

REFERENCES, UNIT 2.2

REQUIREMENTS AND TURNOVER RATES

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
JWMAA	39--2	355	360	odvi	milk consumpti weight gain	robbins,ct; moen,	1975

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
AJVRA	31--4	673	677	odhe	dosh, tot body watr turnov	longhurst,wm; ba/	1970
JWMAA	18--4	540	541	odhe	summer wate consumpt deser	elder,jb	1951
JWMAA	33--2	389	393	odhe	water turnover in mule dee	knox,kl; nagy,jg/	1969

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
				ceel			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
				alal			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
CJZOA	54--6	857	862	rata	tritium wat dilu, wat flux	cameron,rd; whit/	1976

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
JWMAA	34--3	570	582	anam	forag, watr consum, produc	beale,dm; smith,a	1970
UTSCB	29--1	3	6	anam	seasonal forage use, utah	beale,dm; scotter	1968
				anam	continued on the next page		

CODEN VO-NU BEPA ENPA ANIM KEY WORDS---------- AUTHORS---------- YEAR

WGFBA 12--- 1 61 anam food hab, abundan, distrib sundstrom,c; hep/ 1973

XIBPA 1.... 250 250 anam water kinetics in pronghor wesley,de; knox,/ 1971

CODEN VO-NU BEPA ENPA ANIM KEY WORDS---------- AUTHORS---------- YEAR

bibi

CODEN VO-NU BEPA ENPA ANIM KEY WORDS---------- AUTHORS---------- YEAR

CAFGA 54--4 289 296 ovca summer water requirements blong,b; pollard, 1968

CODEN VO-NU BEPA ENPA ANIM KEY WORDS---------- AUTHORS---------- YEAR

ovda

CODEN VO-NU BEPA ENPA ANIM KEY WORDS---------- AUTHORS---------- YEAR

obmo

CODEN VO-NU BEPA ENPA ANIM KEY WORDS---------- AUTHORS---------- YEAR

oram

CODEN VO-NU BEPA ENPA ANIM KEY WORDS---------- AUTHORS---------- YEAR

AJAEA 19--4 655 672 doca eff wat restrc & exer, dig thornton,rf; yate 1968

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
JANSA	35--6	1271	1274	dosh	eff wat restric nutrnt dig	asplund,jm; pfand	1972

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
PNUSA	16--2	108	112		functions of water in body	robinson,jr	1957
SZSLA	31---	261	296	mamm	comprtv watr & energ econo	macfarlane,wv; ho	1972
YAXAA	1955-	14	18		animals and fowl and water	sykes,jf	1955

CHAPTER 9, WORKSHEET 2.2a

Water consumption as part of forage ingested

The amount of water ingested with the forage may be determined if the amounts of forage ingested are determined based on energy or protein requirements as discussed in CHAPTER 12. The calculations of forage ingested are made on a dry weight basis, so the water fraction of field-weight forage must be known.

Determine the water fraction of field-weight forage, calculate dry-weight forage required to meet energy and protein requirements, and estimate the water component of the diet. Compare this to the limited data on water consumption.