TOPIC 1. APPRAISALS OF SEASONAL RANGE CONDITIONS

Weather parameters were discussed in CHAPTER 14. The expression of weather parameters over time is an important dimension in ecology because plants and animals have seasonal adaptations to changing weather conditions.

The four UNITS in this TOPIC illustrate the uses of time-dependent equations presented in CHAPTER 14. Calculations of weather parameters based on the general trends are made for 7-day intervals during each of the seasons, resulting in weather profiles, or cross-sections of average weather conditions on each of these days. Since sample equations have been given in CHAPTER 14 and WORKSHEETS set up for their use, the UNITS in this CHAPTER contain just the formats for calculating profiles. The reader should fit local data to equations described in CHAPTER 14 and complete the profiles in the WORKSHEETS provided.

Animals do not live according to average weather conditions expressed by general trends, however. The use of time-dependent equations expressing averages does call attention to changes over time. If average changes can be related to the animals, then deviations from the average can also be related to animal responses. This is discussed further in TOPIC 2. Animal-range relationships have been studied by Mackie (1970) for mule deer, elk, and cattle, illustrating some of the seasonal charcteristics of both the range and the animals grazing on it. Such year-long studies should be completed on more species, and mathematical equations used to present animal and range characteristics throughout the year.

Many of the references listed at the ends of the four UNITS in TOPIC 1 include general habitat descriptions. They are included here even if there is little or no information on thermal characteristics, because cover and other habitat characteristics are used when evaluating weather effects on animals. Additional general range conditions are found in PART VII: THE MANAGEMENT OF WILD RUMINANTS.

LITERATURE CITED

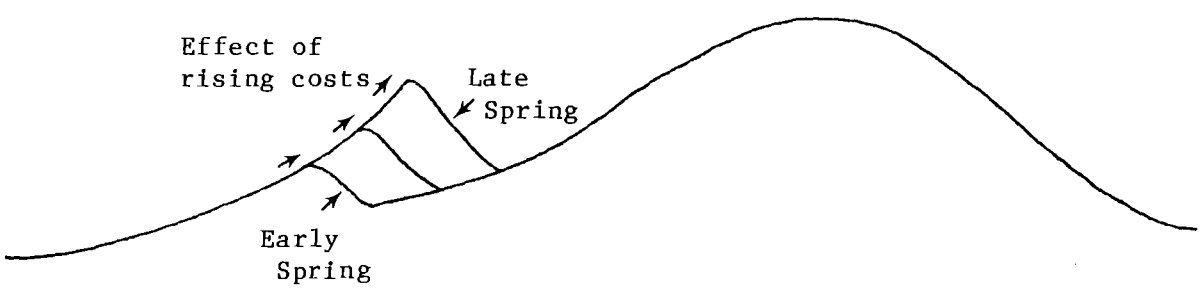
Mackie, R. J. 1970. Range ecology and relations of mule deer, elk, and cattle in the Missouri River Breaks, Montana. Wildlife Monographs 20:1-79.

UNIT 1.1: RANGE CONDITIONS IN THE SPRING

Spring (from March 21, JDAY 80 to June 20, JDAY 171) is a time of reawakening of the range. Snows melt, rains come, the length of daylight is increasing, temperatures are increasing, and dormant plants begin to grow again. The spring range of wild ruminants shows a general and often rapid improvement in range quality.

Two especially important considerations may be made in the spring. One is the timing of the arrival of spring, and the other is the weather conditions when the young are born.

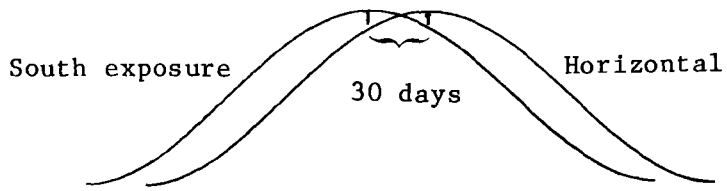
The timing of the arrival of spring is especially important for all wild ruminants since the females are in the last part of gestation, with increasing metabolic costs that must be met if fetal growth is to be up to potential. A late-arriving spring delays improvements in range quality while gestation costs continue to increase, resulting in a less-than-optimal animal-range relationship during the last one-third of the gestation period. The effect of these rising costs on forage intake is illustrated as a pattern below; specific calculations are made in Moen (1978).



South slope deer concentrations are observed in areas where snow depths diminish as a result of higher solar insolation and warmer air temperatures. These sites literally experience the arrival of spring earlier than north exposures do. In fact, north exposures with overhead canopies may be as much as a month behind in range phenology in northern states and Canada.

Seasonal temperature patterns and changes in the amounts of solar radiation through the year were discussed in CHAPTER 14. The use of these sine-wave patterns helps one evaluate the relative benefits of topography on local thermal conditions.

In the illustration at the top of the next page, a 5° warmer temperature due to higher solar radiation and absorption is shown to be equivalent to about 30 days of trend time.



Such differences do not make overall range conditions 30 days ahead, of course, since slope effects are minimal at night, and plant production does not advance as rapidly as temperatures illustrated above might. It is important to evaluate physical and biological processes in the ecological context rather than as separate entities.

Caribou travel in the spring to traditional calving grounds. These calving grounds are often on south slopes and exposures where snow depths are less and thermal conditions are more favorable to the animals.

Weather conditions during parturition are particularly important because of the potential for high heat loss from neonates exposed to wet conditions. Newborn fawns spend over 90% of their time bedded during the first few days of life. Two or three days of cool, wet weather will wet them thoroughly, and the high heat of vaporization may result in excessive heat loss and hypothermia. Thus appraisals of spring range should focus on weather conditions that affect the growth of plants, the thermal balance of neonates, and the productivity of reproducing females.

Listing of average weather conditions on a given day using time-dependent equations results in "profiles," or "cross-sections" of average weather conditions at that point in time. Such a profile may include the following:

JDAY _____

Solar radiation _____

Average air temperature _____

Maximum air temperature _____

Minimum air temperature _____

Infrared radiation _____

Rain _____

Snow _____

Average wind velocity _____

Weather profiles for the spring season should be made for JDAY's 84, 91, 98, ... 168, covering the period from March 25 through June 17. The WORKSHEET at the end of this UNIT includes the necessary equation references and the tabular format for making your own profiles.

LITERATURE CITED

Moen, A. N. 1978. Seasonal changes in heart rates, activity, metabolism, and forage intake of white-tailed deer. J. Wildl. Manage. 42(4):715-738.

REFERENCES, UNIT 1.1

RANGE CONDITIONS IN THE SPRING

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
CAFGA	34--4	189	207	od--	range surv methods, mangmt	dasmann,wp	1948
JWMAA	24--4	387	395	od--	deer-for hab relnshps, ark	halls,lk; crawfor	1960
PMACA	46...	277	287	od--	mrtlty, two priv hunt club	blouch,ri	1961

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
CAFNA	90--2	123	136	odvi	distr, movs reln env fctrs	drolet,ca	1976
JAPEA	14--2	419	432	odvi	classif habita types, vege	stocker,m; gilbe/	1977
JAPEA	14--2	433	444	odvi	veg habitat relns, classif	stocker,m; gilber	1977
JWMAA	19--3	358	364	odvi	rnge apprsl, missouri ozar	dunkeson,rl	1955
JWMAA	33--4	881	887	odvi	repro pattrns rel nutr pln	verme,lj	1969
MGQPA	31...	62	74	odvi	spring ecolg, nc minnesota	pierce,de,jr	1971
NAWTA	13...	442	449	odvi	anal range, adirndacks, ny	webb,wl	1948
NAWTA	20---	568	588	odvi	factrs infl dee, ariz brsh	hanson,wr; mccull	1955
NAWTA	24---	201	215	odvi	evergl hrd, rng cond, life	loveless,cm; liga	1959

odvi continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
NYCOA	27--2	28	31	odvi	weather and the deer popul	severinghaus,cw	1972
NYCOA	29--4	18	20	odvi	advances, science deer mgt	severinghaus,cw	1975
PCGFA	10---	53	58	odvi	deer nutr prob,s pine type	lay,dw	1956
PSAFA	1955-	130	132	odvi	odhe,for ecol relatns,mich	westell,ce,jr	1955
RWLBA	6---2	327	385	odvi	wint, spr obsrv, adirndcks	spiker,cj	1933
TJSCA	24...	457	489	odvi	w-td of aransas refug, tex	white,m	1973
TWASA	48---	49	56	odvi	deer populns in early wisc	habeck,jr; curtis	1959
WLSBA	5---3	113	117	odvi	quantif veg struc of cover	nudds,td	1977
WLSBA	6---2	88	90	odvi	fat cycle	mautz,ww	1978
WSCBA	13--3	7	7	odvi	environment and deer	wiscn consrv dept	1948
XFNCA	39---	2	10	odvi	deer rng apprais in midwes	murphy,da	1970

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
ECMOA	2----	1	46	odhe	seasonal migratn of mule d	russell,cp	1932
JRMGA	30--2	122	127	odhe	eval habita on nutri basis	wallmo,oc; carpe/	1977
JWMAA	27--2	196	202	odhe	relatn to climatic gradint	dasmann,rf; dasma	1963
NAWTA	20---	568	588	odhe	factrs infl dee, ariz brsh	hanson,wr; mccull	1955
NAWTA	29---	404	414	odhe	ceel, doca, sum rang, utah	julander,o; jeffe	1964
NEXAA	567--	1	32	odhe	ft stanton hrd, ecol, n mx	wood,je; bickle,/	1970
WLMOA	20---	1	79	odhe	ceel, doca, rnge ecol, mon	mackie,rj	1970
XFPNA	125..	1	99	odhe	habita char of silv lk rng	dealy,je	1971

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
XFIPA	24---	1	15	ceel	od, probs hab mgt, n fores	lyon,lj	1966

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
BINPA	12...	23	32	alal	moos, mskeg brch, beav env	lulman,pd	1974
JWMAA	40--4	645	657	alal	odvi,hbitat use,symptr rng	kearney,sr; gilbe	1976

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
ATICA	27...	256	264	rata	ovmo, northw territ, canad	kevan,pg	1974
CWRSB	33--	1	82	rata	invstg carib rnge, nw terr	parker,gr	1975
UABPA	1----	414	419	rata	weath effct on behav, migr	gavin,a	1975

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

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
CAFNA	87--4	433	454	ovca	chilcotin river bigh popul	demarchi,da; mitc	1973

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
JWMAA	3---4	295	306	many	yellowst wint rnge studies	grimm,rl	1939
JWMAA	43--2	437	444	many	hbitat partitng,fire, mont	singer,fj	1979

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
JRMGA	2---1	53	63	----	meth det util range forage	heady,hf	1949
JRMGA	7---1	14	23	----	applctn ecol, det rnge cnd	parker,kw	1954
JRMGA	10--5	208	212	----	steppoint method, sampling	evans,ra; love,rm	1957
JRMGA	18--4	196	201	----	comm use gras capac key sp	smith,ad	1965
JRMGA	24--1	55	59	----	seas trnds herb, nutr prod	sims,pl; love,rm	1971
NAWTA	10---	251	256	biga	b ga-liv compet, west rang	stoddart,la; rasm	1945
TWASA	53...	123	129	wldl	habitat and managed forest	stearns,fw; creed	1964

CHAPTER 17, WORKSHEET 1.1a

Weather profiles during the spring season

Weather profiles for each of the JDAY's from March 26 (JDAY 85) through June 18 (JDAY 169) at 7-day intervals may be completed by referring to the equations below.

SORA: See CHAPTER 14, WORKSHEET 1.1a
ADTC: See CHAPTER 14, WORKSHEET 2.1a - 2.1c
AMXT: See CHAPTER 14, WORKSHEET 2.1b
AMNT: See CHAPTER 14, WORKSHEET 2.1b
QREE: See CHAPTER 14, WORKSHEET 1.2a (complete ADTC first)
RAIN: See CHAPTER 14, WORKSHEET 5.2b
SNOW: See CHAPTER 14, WORKSHEET 5.2b
WIVE: See CHAPTER 14, WORKSHEET 3.2a
(Use Z_o characteristic of snow or vegetation if expressing wind velocity for a selected animal height)

Complete the calculations using equations derived for your local area and tabulate the results below.

					QREE*			PREC		
JDAY	SORA	ADTC	AMXT	AMNT				RAIN	SNOW	WIVE
85	____	____	____	____	____	____	____	____	____	____
92	____	____	____	____	____	____	____	____	____	____
99	____	____	____	____	____	____	____	____	____	____
106	____	____	____	____	____	____	____	____	____	____
113	____	____	____	____	____	____	____	____	____	____
120	____	____	____	____	____	____	____	____	____	____
127	____	____	____	____	____	____	____	____	____	____
134	____	____	____	____	____	____	____	____	____	____
141	____	____	____	____	____	____	____	____	____	____
148	____	____	____	____	____	____	____	____	____	____
155	____	____	____	____	____	____	____	____	____	____
162	____	____	____	____	____	____	____	____	____	____
169	____	____	____	____	____	____	____	____	____	____

*Three blanks are given for different cover types, or for downward, upward and total infrared radiation.

JDAY	SORA	ADTC	AMXT	AMNT	QREE*			PREC		WIVE
								RAIN	SNOW	
85	____	____	____	____	_____	_____	_____	____	____	____
92	____	____	____	____	_____	_____	_____	____	____	____
99	____	____	____	____	_____	_____	_____	____	____	____
106	____	____	____	____	_____	_____	_____	____	____	____
113	____	____	____	____	_____	_____	_____	____	____	____
120	____	____	____	____	_____	_____	_____	____	____	____
127	____	____	____	____	_____	_____	_____	____	____	____
134	____	____	____	____	_____	_____	_____	____	____	____
141	____	____	____	____	_____	_____	_____	____	____	____
148	____	____	____	____	_____	_____	_____	____	____	____
155	____	____	____	____	_____	_____	_____	____	____	____
162	____	____	____	____	_____	_____	_____	____	____	____
169	____	____	____	____	_____	_____	_____	____	____	____

*Three blanks are given for different cover types, or for downward, upward and total infrared radiation.

UNIT 1.2: RANGE CONDITIONS IN THE SUMMER

Range conditions in the summer, from the summer solstice (June 21; JDAY 172) to the fall equinox (September 20; JDAY 263), vary from hot and dry to wet and cool, with the possibility of snow and cold in the northern latitudes and the higher elevations, especially in September.

Maximum solar radiation reaches the earth on June 21, and then the apparent elevation of the sun begins to decrease, and daylength also decreases. The decrease is slow at first, increasing to maximum rate at the fall equinox.

Air temperature trends lag behind the solar radiation trends as net radiation is still positive for several weeks after the summer solstice. Maximum temperatures are usually reached in late July or early August.

Wind velocities do not exhibit the marked seasonal trends that solar radiation and air temperatures do. Plant cover is heavier than at any other time of year in most areas, so effective wind velocities are much reduced in many habitats.

Precipitation patterns are usually very seasonal, with summer being one of the drier periods of the year in many areas. There are many local variations, of course, depending on topography and the number and size of bodies of water present.

Weather profiles for the summer season should be made for JDAY's 175, 182, 189 ... 259, covering the period from June 24 through September 16. The WORKSHEET at the end of this UNIT includes the necessary equation references and the tabular format for making your own profiles.

REFERENCES, UNIT 1.2

RANGE CONDITIONS IN THE SUMMER

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
CAFGA	34--4	189	207	od--	range surv methods, mangmt	dasmann,wp	1948
JWMAA	13--3	314	315	od--	deer forag observtns, utah	smith,jg	1949
JWMAA	24--4	387	395	od--	deer-for hab relnshps, ark	halls,lk; crawfor	1960
NAWTA	10---	234	241	od--	ceel, meth det nums & rnge	hunter,gn	1945

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
AMNAA	61--1	230	238	odvi	histor view of rnges, wisc	christensen,em	1959
CAFNA	90--2	123	136	odvi	distr, movs reln env fctrs	drolet,ca	1976
JAPEA	14--2	419	432	odvi	classif habita types, vege	stocker,m; gilbe/	1977
JAPEA	14--2	433	444	odvi	veg habitat relns, classif	stocker,m; gilber	1977
JWMAA	19--3	358	364	odvi	rnge apprsl, missouri ozar	dunkeson,rl	1955
JWMAA	33--4	881	887	odvi	repro pattrns rel nutr pln	verme,lj	1969
JWMAA	35--3	476	487	odvi	summer habitat, nc minneso	kohn,be; mooty,jj	1971
NAWTA	13...	442	449	odvi	anal range, adirndacks, ny	webb,wl	1948
NAWTA	24---	201	215	odvi	evergl hrd, rng cond, life	loveless,cm; liga	1959
NYCOA	29--4	18	20	odvi	advances, science deer mgt	severinghaus,cw	1975
PCGFA	10---	53	58	odvi	deer nutr prob,s pine type	lay,dw	1956
PSAFA	1955-	130	132	odvi	odhe,for ecol relatn, mich	westell,ce,jr	1955
TJSCA	24...	457	489	odvi	wt-d of aransas refug, tex	white,m	1973
TWASA	48---	49	56	odvi	deer populns in early wisc	habeck,jr; curtis	1959
WCDBA	44---	1	104	odvi	signif forest openin, wisc	mccaffery,kr; cre	1969
WLSBA	5---3	113	117	odvi	quantif veg struc of cover	nudds,td	1977
WLSBA	6---2	88	90	odvi	fat cycle	mautz,ww	1978
WSCBA	13--3	7	7	odvi	environment and deer	wiscn consrv dept	1948
XFNCA	39---	2	10	odvi	deer rng apprais in midwes	murphy,da	1970

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
ECMOA	2----	1	46	odhe	seasonal migratn of mule d	russell,cp	1932
JRMGA	4---4	249	253	odhe	ceel, status of brws, oreg	mitchell,ge	1951
JRMGA	30--2	122	127	odhe	eval habita on nutri basis	wallmo,oc; carpe/	1977
JWMAA	25--1	54	60	odhe	rel sum rng cond, hrd prod	julander,o; robi/	1961
JWMAA	27--2	196	202	odhe	relatn to climatc gradient	dasmann,rf; dasma	1963
JWMAA	34--4	852	862	odhe	dee respons, mgt summ rang	hungerford,cr	1970
JWMAA	39--3	605	616	odhe	doca, rng relns, prair hab	dusek,gl	1975
NAWTA	20---	568	588	odhe	factrs infl dee, ariz brsh	hanson,wr; mccull	1955
NAWTA	29---	404	414	odhe	ceel, doca, sum rang, utah	julander,o; jeffe	1964

odhe continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
NEXAA	567--	1	32	odhe	ft stanton hrd, ecol, n mx	wood,je; bickle,/	1970
WLMOA	20---	1	79	odhe	ceel, doca, rng ecol, mont	mackie,rj	1970
XFPNA	125..	1	99	odhe	habita char of silv lk rng	dealy,je	1971

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
XFIPA	24---	1	15	ceel	od, probs hab mgt, n fores	lyon,lj	1966

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
BINPA	12...	23	32	alal	moos, mskeg brch, beav env	lulman,pd	1974
JRMGA	16--5	227	231	alal	apprais moose rang, montan	peek,jm	1963
JWMAA	40--4	645	657	alal	odvi,hbitat use symptr rng	kearney,sr; gilbe	1976

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
CWRSB	33---	1	83	rata	invstg carib rnge, nw terr	parker,gr	1975
RIJUA	30---	289	293	rata	intractins w/ habita, alas	klein,dr	1970
XFWWA	43---	1	48	rata	st matthew isl reind range	klein,dr	1959

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
NAWTA	15---	627	644	anam	rng ecol, wichita mts refu	buechner,hk	1950
UTSCB	29--1	3	6	anam	season forage use, w utah	beale,dm; scotter	1968

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
CAFNA	87--4	433	454	ovca	chilcotin river bigh popul	demarchi,da; mitc	1973

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
JRMGA	23--1	8	14	obmo	rata,tndra n of boreal for	klein,dr	1970
JWMAA	40--1	151	162	obmo	rata, summ rnge relns, nwt	wilkinson,pf; sh/	1976

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
JWMAA	37--3	353	362	oram	forage, habitat pref, alas	hjeljord,o	1973

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
XAGCA	796--	1	27	doca	forg utiliz summ rnge, ore	pickford,gd; reid	1948

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
JRMGA	2---1	53	63	----	meth det util range forage	heady,hf	1949
JRMGA	7---1	14	23	----	applctn ecol, det rnge cnd	parker,kw	1954
JRMGA	10--5	208	212	----	steppoint method, sampling	evans,ra; love,rm	1957
JRMGA	24--1	55	59	----	seas trnds herb, nutr prod	sims,pl; love,rm	1971
NAWTA	10---	251	256	biga	b ga-liv compet, west rang	stoddart,la; rasm	1945
NAWTA	27---	150	164	----	rumen cont, index rng qual	klein,dr	1962
TWASA	53...	123	129	wldl	habitat and managed forest	stearns,fw; creed	1964

CHAPTER 17, WORKSHEET 1.2a

Weather profiles during the summer season

Weather profiles for each of the JDAY's from June 25 (JDAY 176) through September 17 (JDAY 260) at 7-day intervals may be completed by referring to the equations below.

SORA: See CHAPTER 14, WORKSHEET 1.1a
ADTC: See CHAPTER 14, WORKSHEET 2.1a - 2.1c
AMXT: See CHAPTER 14, WORKSHEET 2.1b
AMNT: See CHAPTER 14, WORKSHEET 2.1b
QREE: See CHAPTER 14, WORKSHEET 1.2a (complete ADTC first)
RAIN: See CHAPTER 14, WORKSHEET 5.2b
SNOW: See CHAPTER 14, WORKSHEET 5.2b
WIVE: See CHAPTER 14, WORKSHEET 3.2a
(Use Z_o characteristic of snow or vegetation if expressing wind velocity for a selected animal height)

Complete the calculations using equations derived for your local area and tabulate the results below.

					QREE*			PREC		
JDAY	SORA	ADTC	AMXT	AMNT				RAIN	SNOW	WIVE
176	____	____	____	____	____	____	____	____	____	____
183	____	____	____	____	____	____	____	____	____	____
190	____	____	____	____	____	____	____	____	____	____
197	____	____	____	____	____	____	____	____	____	____
204	____	____	____	____	____	____	____	____	____	____
211	____	____	____	____	____	____	____	____	____	____
218	____	____	____	____	____	____	____	____	____	____
225	____	____	____	____	____	____	____	____	____	____
232	____	____	____	____	____	____	____	____	____	____
239	____	____	____	____	____	____	____	____	____	____
246	____	____	____	____	____	____	____	____	____	____
253	____	____	____	____	____	____	____	____	____	____
260	____	____	____	____	____	____	____	____	____	____

*Three blanks are given for different cover types, or for downward, upward and total infrared radiation.

JDAY	SORA	ADTC	AMXT	AMNT	QREE*			PREC		WIVE
								RAIN	SNOW	
176	____	____	____	____	_____	_____	_____	____	____	____
183	____	____	____	____	_____	_____	_____	____	____	____
190	____	____	____	____	_____	_____	_____	____	____	____
197	____	____	____	____	_____	_____	_____	____	____	____
204	____	____	____	____	_____	_____	_____	____	____	____
211	____	____	____	____	_____	_____	_____	____	____	____
218	____	____	____	____	_____	_____	_____	____	____	____
225	____	____	____	____	_____	_____	_____	____	____	____
232	____	____	____	____	_____	_____	_____	____	____	____
239	____	____	____	____	_____	_____	_____	____	____	____
246	____	____	____	____	_____	_____	_____	____	____	____
253	____	____	____	____	_____	_____	_____	____	____	____
260	____	____	____	____	_____	_____	_____	____	____	____

*Three blanks are given for different cover types, or for downward, upward and total infrared radiation.

UNIT 1.3: RANGE CONDITIONS IN THE FALL

The period of time from the fall equinox (September 21; JDAY 264) to the winter solstice (December 20; JDAY 354) is characterized by shorter days, decreasing solar radiation, cooler temperatures, and precipitation in the form of snow rather than rain in the northern regions of the U.S. and Canada, and at the higher elevations.

The growing season is over. Leaves have fallen from deciduous trees, and herbaceous plants are dormant. The habitat presents a different morphology from summer conditions. Thermal cover is less effective as protection from the weather due to leaf fall.

The shortest day of the year occurs on December 21, with increasingly less daylight up to this date at the more northern latitudes, and no direct sunlight beyond the Arctic Circle on this date.

Weather profiles for the fall season should be made for JDAY's 266, 273, 280 ... 350, covering the period from September 21 through December 20. The WORKSHEET at the end of this UNIT includes the necessary equation references and the tabular format for making your own profiles.

REFERENCES, UNIT 1.3

RANGE CONDITIONS IN THE FALL

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
CAFGA	34--4	189	207	od--	range surv methods, mangmt	dasmann,wp	1948
JWMAA	13--3	314	315	od--	deer forag observtns, utah	smith,jg	1949
NAWTA	10---	234	241	od--	ceel, meth det nums & rnge	hunter,gn	1945
PMACA	46...	277	287	od--	mrtlty, two priv hunt club	blouch,ri	1961

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
CAFNA	90--2	123	136	odvi	distr, movs reln env fctrs	drolet,ca	1976
JAPEA	14--2	419	432	odvi	classif habita types, vege	stocker,m; gilbe/	1977
JAPEA	14--2	433	444	odvi	veg habitat relns, classif	stocker,m; gilber	1977

odvi continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
JWMAA	19--3	358	364	odvi	rnge apprsl, missouri ozar	dunkeson,rl	1955
JWMAA	33--4	881	887	odvi	repro pattrns rel nutr pln	verme,lj	1969
MGQPA	31...	142	150	odvi	fall ecology, nc minnesota	waddell,bh	1971
NAWTA	13...	442	449	odvi	anal range, adirndacks, ny	webb,wl	1948
NAWTA	24---	201	215	odvi	evergl hrd, rng cond, life	loveless,cm; liga	1959
NYCOA	29--4	18	20	odvi	advances, science deer mgt	severinghaus,cw	1975
PCGFA	10---	53	58	odvi	deer nutr prob,s pine type	lay,dw	1956
PSAFA	1955-	130	132	odvi	odhe,for ecol relatn, mich	westell,ce,jr	1955
TJSCA	24...	457	489	odvi	w-td of aransas refug, tex	white,m	1973
TWASA	48---	49	56	odvi	deer populns in early wis	habeck,jr; curtis	1959
WLSBA	5---3	113	117	odvi	quantif veg struc of cover	nudds,td	1977
WLSBA	6---2	88	90	odvi	fat cycle	mautz,ww	1978
WSCBA	4---5	18	24	odvi	report of two deer yards	minor,ft; hanson,	1939
WSCBA	13--3	7	7	odvi	environment and deer	wiscn consrv dept	1948
XFNCA	39---	2	10	odvi	deer rng apprais in midwes	murphy,da	1970

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
ECMOA	2----	1	46	odhe	seasonal migratn of mule d	russell,cp	1932
JRMGA	30--2	122	127	odhe	eval habita on nutri basis	wallmo,oc; carpe/	1977
JWMAA	27--2	196	202	odhe	relatn to climatc gradient	dasmann,rf; dasma	1963
NAWTA	20---	568	588	odhe	factrs infl dee, ariz brsh	hanson,wr; mccull	1955
NAWTA	29---	404	414	odhe	ceel, doca, sum rang, utah	julander,o; jeffe	1964
NEXAA	567--	1	32	odhe	ft stanton hrd, ecol, n mx	wood,je; bickle,/	1970
WLMOA	20---	1	79	odhe	ceel,doca rng ecol, montan	mackie,rj	1970
XFPNA	125..	1	99	odhe	habita char of silv lk rng	dealy,je	1971

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
XFIPA	24---	1	15	ceel	od, probs hab mgt, n fores	lyon,lj	1966

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
BINPA	12...	23	32	alal	moos, mskeg brch, beav env	lulman,pd	1974
JWMAA	40--4	645	657	alal	odvi,hbitat use,symptr rng	kearney,sr; gilbe	1976

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
CWRSB	33---	1	83	rata	invstg carib rnge, nw terr	parker,gr	1975

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

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
CAFNA	87--4	433	454	ovca	chilcotin river bigh popul	demarchi,da; mitc	1973

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
JWMAA	37--3	353	362	oram	forage, habitat pref, alas	hjeljord,o	1973

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
JWMAA	3---4	295	306	many	yellowst wint rnge studies	grimm,dm; scotter	1968
JWMAA	43--2	437	444	many	hbitat partitng,fire, mont	singer,fj	1979

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
JRMGA	2---1	53	63	----	meth det util range forage	heady,hf	1949
JRMGA	7---1	14	23	----	applctn ecol, det rnge cnd	parker,kw	1954
JRMGA	10--5	208	212	----	steppoint method, sampling	evans,ra; love,rm	1957
JRMGA	24--1	55	59	----	seas trnds herb, nutr prod	sims,pl; love,rm	1971
NAWTA	10---	251	256	biga	b ga-liv compet, west rang	stoddart,la; rasm	1945
TWASA	53...	123	129	wldl	habitat and managed forest	stearns,fw; creed	1964

CHAPTER 17, WORKSHEET 1.3a

Weather profiles during the fall season

Weather profiles for each of the JDAY's from September 24 (JDAY 267) through December 17 (JDAY 351) at 7-day intervals may be completed by referring to the equations below.

SORA: See CHAPTER 14, WORKSHEET 1.1a
ADTC: See CHAPTER 14, WORKSHEET 2.1a - 2.1c
AMXT: See CHAPTER 14, WORKSHEET 2.1b
AMNT: See CHAPTER 14, WORKSHEET 2.1b
QREE: See CHAPTER 14, WORKSHEET 1.2a (complete ADTC first)
RAIN: See CHAPTER 14, WORKSHEET 5.2b
SNOW: See CHAPTER 14, WORKSHEET 5.2b
WIVE: See CHAPTER 14, WORKSHEET 3.2a
(Use Z_o characteristic of snow or vegetation if expressing wind velocity for a selected animal height)

Complete the calculations using equations derived for your local area and tabulate the results below.

					QREE*			PREC		
JDAY	SORA	ADTC	AMXT	AMNT				RAIN	SNOW	WIVE
267	____	____	____	____	____	____	____	____	____	____
274	____	____	____	____	____	____	____	____	____	____
281	____	____	____	____	____	____	____	____	____	____
288	____	____	____	____	____	____	____	____	____	____
295	____	____	____	____	____	____	____	____	____	____
302	____	____	____	____	____	____	____	____	____	____
309	____	____	____	____	____	____	____	____	____	____
316	____	____	____	____	____	____	____	____	____	____
323	____	____	____	____	____	____	____	____	____	____
330	____	____	____	____	____	____	____	____	____	____
337	____	____	____	____	____	____	____	____	____	____
344	____	____	____	____	____	____	____	____	____	____
351	____	____	____	____	____	____	____	____	____	____

*Three blanks are given for different cover types, or for downward, upward and total infrared radiation.

JDAY	SORA	ADTC	AMXT	AMNT	QREE*			PREC		WIVE
								RAIN	SNOW	
267	____	____	____	____	_____	_____	_____	____	____	____
274	____	____	____	____	_____	_____	_____	____	____	____
281	____	____	____	____	_____	_____	_____	____	____	____
288	____	____	____	____	_____	_____	_____	____	____	____
295	____	____	____	____	_____	_____	_____	____	____	____
302	____	____	____	____	_____	_____	_____	____	____	____
309	____	____	____	____	_____	_____	_____	____	____	____
316	____	____	____	____	_____	_____	_____	____	____	____
323	____	____	____	____	_____	_____	_____	____	____	____
330	____	____	____	____	_____	_____	_____	____	____	____
337	____	____	____	____	_____	_____	_____	____	____	____
344	____	____	____	____	_____	_____	_____	____	____	____
351	____	____	____	____	_____	_____	_____	____	____	____

*Three blanks are given for different cover types, or for downward, upward and total infrared radiation.

UNIT 1.4: RANGE CONDITIONS IN THE WINTER

Winter range (December 21, JDAY 355 - March 20, JDAY 29) is dominated by three main features over much of the wild ruminant range in North America. They are increasing and prolonged snow accumulations and cold weather conditions, decreasing forage supplies, and restrictions in area as groups of animals move over smaller areas, seeking habitats with topography and cover that provide protection from wind and winter weather conditions that cause high energy losses.

Snow accumulations are a significant factor in determining the forage supplies available and the extent of the winter range. The total amounts of snowfall and amounts on the ground are measured and reported by many weather observers throughout the country. Amounts in habitats used by wild ruminants may be different from amounts in areas measured by weather observers, however. The use of formulas as in CHAPTER 14, UNIT 5.2 for estimating percent interception as a function of canopy cover is a step in the right direction, making winter range appraisals more pertinent to the animals rather than being merely weather reports.

Other factors in addition to snowfall and interception are also important on winter range. Canopy characteristics also affect snowpack characteristics. A heavy canopy reduces the rate of aging of the snow, and the potential for crust formation. Aged snow with a crust has the potential for supporting deer, and this can be beneficial to the animals as they spend less energy walking on snow than through it, they are not so confined to trails, and they are within reach of new forage supplies when they walk on accumulated snow. All of these benefits, however, can neither be managed nor can they be counted on to occur, and this brings up an important concept in winter range appraisals.

Evaluate winter range in relation to how it relates to the animal as if the worst will occur. If, for example, 30 inches (about 75 cm) of snow falls, consider the animal to be exposed to 30 inches of fallen snow, or at best the 30 inches less the intercepted snow. Do not count on the probability of a thaw and crust formation occurring, for it is better to be a bit cautious and wrong than to be too optimistic. Such a conservative approach results in positive errors that can be considered in subsequent management decisions.

The winter range provides recreational opportunities for people that may interact with wild ruminants. Thus deep and prolonged snow is not only a potential detriment to animals but a potential benefit to recreational activities. These activities may also be detrimental to animals. The effects of snowmobiles on deer are discussed in UNIT 2.4.

Snow is one major factor to be concerned with in the winter range. Temperature is another. Cold temperatures minimize the rate of aging of the snow, keeping it deeper and less dense as settling and melting do not occur. This is a potentially critical situation as loose, fluffy snow is a very important mechanical barrier to movement when its depth exceeds belly height

and animals must bound to move through it. Up to belly heights, loose snow is walked through more easily than dense snow.

Air temperatures are also of interest in relation to heat loss from animals as colder temperatures result in a steeper gradient between the metabolic tissue of the animal and the temperature of the air. The effects of this on the animal are discussed in UNIT 2.4.

Wind is an important characteristic of the range in the winter because of the high potential for heat loss when combined with lower air temperatures. Wind velocities vary vertically in relation to the roughness of the surface and horizontally over areas of different topography and cover types (See CHAPTER 14, UNIT 3.2). Wind velocities reported by weather observers at meterology stations are not characteristic of wind velocities in areas inhabited by wild ruminants because of the heights and open conditions in which weather observers measure velocities.

There have been attempts to derive "winter severity indexes" as measures of range conditions during the winter by measuring various weather parameters and relating them directly to condition and mortality of the animals. The establishment of such correlations usually takes many years as a wide range of winter conditions are needed to make the appropriate comparisons and judgements. The "katathermometer" approach, in which a warm or heated device is placed in winter habitat and its rate of cooling or the electrical energy needed to keep it warm measured, has also been tried. The results are highly correlated with weather parameters such as temperature and wind, but that is expected since the temperature gradients and wind effects on convection losses are the two major factors affecting heat loss from the "katathermometer." Therefore, the results could be predicted by simply measuring temperatures and wind velocities.

The important concept to keep in mind when evaluating thermal characteristics of winter range is that they should be measured in ways that can be applied to the animals. The thermal linkages between animal and environment are radiation exchange, convection, conduction, and evaporation. These four basic modes of heat transfer occur at rates proportional to atmospheric conditions and habitat and animal characteristics. Atmospheric conditions, commonly called weather, are not directly proportioned to heat transfer, however. Radiation exchange is a function of the 4th power of the absolute temperature, convection is a function of the square root of wind speed, conduction is a function of substrate temperatures, and all of these are affected by additional habitat and animal characteristic. The alternative approach is the application of winter range characteristics to the "overall heat transfer coefficient" analyses discussed in CHAPTER 16, TOPIC 2. Some of the effects of different behavioral options are discussed in UNIT 2.4 of this CHAPTER 17.

Weather profiles for the winter season should be made for JDAY's 357, 364, 8 ... 77, covering the period from December 21 through March 20. The WORKSHEET at the end of this UNIT includes the necessry equation referrences and the tabular format for making your own calculations.

REFERENCES, UNIT 1.4

RANGE CONDITIONS IN THE WINTER

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
FUOFA	66...	174	186	cerv	wint prob, northern cervid	markgren,g	1971
VILTA	9---3	45	169	cerv	win habita, lnd use, scand	ahlen,i	1975

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
CAFGA	34--4	189	207	od--	ceel, meth det nums & rang	hunter,gn	1945
CAFGA	34--4	189	207	od--	range surv methods, mangmt	dasmann,wp	1948
CAFGA	35--1	103	114	od--	interstate wint mgmnt plan	intrst dr hrd com	1949
CAFGA	44--1	51	72	od--	survi, rng forag trnds, ca	dasmann,wp; hjers	1958
JWMAA	31--3	426	432	od--	deer rang appraisal, e tex	lay,dw	1967
PMACA	46...	277	287	od--	mrtlty, two priv hunt club	blouch,ri	1961
XFWRA	16-10	1	17	od--	winter range studies	randle,ac	1938
XFWRA	26-33	1	11	od--	wintr range survey, oregon	edwards,o	1939
XFWRA	41-44	1	20	od--	winter range, intrstat hrd	fischer,ga; dav/	1944

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
AMNAA	61--1	230	238	odvi	histor view of rnges, wisc	christensen,em	1959
CAFNA	85--2	141	145	odvi	odhe, winter ecol, alberta	kramer,a	1971
CAFNA	88--3	293	301	odvi	wint habita, 31-mi lk, que	huot,j	1974
CAFNA	90--2	123	136	odvi	distr, movs reln env fctrs	drolet,ca	1976
CAFNA	92--1	19	23	odvi	eval wint rng, pt pelee pk	theberge,jb	1978
CJZOA	54--8	1307	1313	odvi	eff wint condtns, manitoba	kucera,e	1976
CWRSB	15---	1	27	odvi	alal, behav in snow, fundy	kelsall,jp; presc	1971
ECOLA	16--4	535	553	odvi	wint relns to forest, mass	hosley,nw; ziebar	1935
ECOLA	43--1	134	135	odvi	class wint habita, no wisc	christensen,em	1962
ECOLA	44--2	411	414	odvi	veg, lowlnd wint hab, mich	christensen,em	1963
ECOLA	57--1	192	198	odvi	energy conservtn in winter	moen,an	1976
ISJRA	47--3	199	217	odvi	pil knb st pk, win dee hav	zagata,md; haugen	1973

odvi continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
JAPEA	14--2	419	432	odvi	classif habita types, vege	stocker,m; gilbe/	1977
JAPEA	14--2	433	444	odvi	veg habitat relns, classif	stocker,m; gilber	1977
JFUSA	47--4	299	299	odvi	winter habita study, maine	glasgow,ll	1949
JFUSA	63--7	523	529	odvi	swamp conifer deeryard, mi	verme,lj	1965
JWMAA	11--2	162	177	odvi	odhe, surv ovr-pop rng, us	leopold,a; sowls/	1947
JWMAA	13--1	135	141	odvi	avail wint forg, hrdwd for	hough,af	1949
JWMAA	19--3	358	364	odvi	rnge apprsl, missouri ozar	dunkeson,rl	1955
JWMAA	23--3	273	278	odvi	veg study wintr rang, wisc	hobeck,jr	1959
JWMAA	24--4	364	371	odvi	test of shelt req pen deer	robinson,wl	1960
JWMAA	24--4	387	395	odvi	deer-for hab relnshps, ark	halls,lk; crawfor	1960
JWMAA	32--3	566	574	odvi	index wint weathr severity	verme,lj	1968
JWMAA	33--3	511	520	odvi	hab-deer relns in enclosur	segelquist,ca; w/	1969
JWMAA	33--4	881	887	odvi	repro pattrns rel nutr pln	verme,lj	1969
JWMAA	35--4	732	743	odvi	limitns of wint aspn brows	ullrey,de; youat/	1971
JWMAA	39--1	59	66	odvi	apprais wint hab, ne minne	wetzel,jf; wamba/	1975
JWMAA	41--4	700	708	odvi	assess mortlty in upp mich	verme,lj	1977
MOCOA	13--1	2	3	odvi	any deer and lots of snow	robb,d	1952
NAWTA	12---	212	223	odvi	reltn weath,wint mort, pop	severinghaus,cw	1947
NAWTA	13...	442	450	odvi	anal wint rang, adirndk,ny	webb,wl	1948
NAWTA	18---	581	596	odvi	yard carry capac, browsing	davenport,la; sw/	1953
NAWTA	24---	201	215	odvi	evergl hrd, rng cond, life	loveless,cm; liga	1959
NFGJA	8---1	61	63	odvi	determinng freq wintr kill	severinghaus,cw	1961
NFGJA	23--1	51	57	odvi	steep slope wintring areas	dickinson,nr	1976
NFGJA	25--2	170	174	odvi	evid brows to map win rnge	dickinson,nr	1978
NYCOA	11--1	11	11	odvi	wntr kill of deer, 1955-56	severinghaus,cw	1956
NYCOA	27--2	28	31	odvi	weather and the deer popul	severinghaus,cw	1972
NYCOA	27--6	37	37	odvi	propos to imprv dee habita	severinghaus,cw	1972
NYCOA	27--5	41	41	odvi	winter deer feeding	kelsey,pm	1973
NYCOA	29--4	18	20	odvi	advances, science deer mgt	severinghaus,cw	1975
PCGFA	10---	53	58	odvi	deer nutr prob,s pine type	lay,dw	1956
PSAFA	1955-	130	132	odvi	odhe,for ecol relatns mich	westell,ce,jr	1955
RWLBA	6---2	327	385	odvi	wint, spr obsrv, adirndcks	spiker,cj	1933
TJSCA	24...	457	489	odvi	wt-d of aransas refug, tex	white,m	1973
TWASA	48---	49	56	odvi	deer populns in early wisc	habeck,jr; curtis	1959
WLSBA	5---3	113	117	odvi	quantif veg struc of cover	nudds,td	1977
WLSBA	6---2	88	90	odvi	fat cycle	mautz,ww	1978

odvi continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
WSCBA	4---5	18	24	odvi	report of two deer yards	minor,ft; hanson,	1939
WSCBA	13--3	7	7	odvi	environment and deer	wiscnsn cnsrv dpt	1948
WSCBA	14--6	21	24	odvi	wint deer rang conds, wisc	dahlberg,bl	1949
WSCBA	20-10	25	27	odvi	flag river deer yard	smith,ae	1955
XFNCA	39---	2	10	odvi	deer rng apprais in midwes	murphy,da	1970
XFNCA	52---	51	59	odvi	eff sno conds vuln to pred	mech,ld; frenzel/	1971

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
CAFGA	40--3	215	234	odhe	dee,forag relnshp wint rng	dasmann,wp; blais	1954
ECMOA	2----	1	46	odhe	seasonal migratn of mule d	russell,cp	1932
ECOLA	53--4	615	625	odhe	shrub age struct, wint rng	roughton,rd	1972
JFUSA	58--9	696	703	odhe	ceel, ecol stud wint range	gysel,lw	1960
JRMGA	2---4	206	212	odhe	livstk,forag stud,wint rng	dasmann,wp	1949
JRMGA	4---4	249	253	odhe	ceel, status of brws, oreg	mitchell,ge	1951
JRMGA	25--1	66	68	odhe	fecal cnt,wint site factrs	anderson,ae; med/	1972
JRMGA	30--2	122	127	odhe	eval habita on nutri basis	wallmo,oc; carpe/	1977
JRMGA	32--1	40	45	odhe	dosh forag selec, wintring	smith,ma; malech/	1979
JWMAA	6---3	210	220	odhe	survy winter range, oregon	edwards,ot	1942
JWMAA	9---2	145	151	odhe	winter study, nevada	aldous,cm	1945
JWMAA	13--4	421	423	odhe	eff deer, lvstk, rng, utah	smith,ad	1949
JWMAA	16--3	289	299	odhe	range conds, mortlty, utah	robinette,wl; ju/	1952
JWMAA	27--2	196	202	odhe	relation to climatic gradi	dasmann,rf; dasma	1963
JWMAA	29--1	27	33	odhe	montane forst win hab, mon	klebenow,da	1965
JWMAA	31--4	651	666	odhe	char herds, range ne utah	richens,vb	1967
JWMAA	34--1	15	23	odhe	effect of now depth on dee	gilbert,pf; wall/	1970
JWMAA	36--2	571	578	odhe	numbs, shrb yld util, wint	anderson,ae; med/	1972
JWMAA	39--3	605	616	odhe	doca, rng relns, prair hab	dusek,gl	1975
JWMAA	42--1	108	112	odhe	b-td wintr rnge, se alaska	bloom,am	1978
NAWTA	6----	132	139	odhe	ceel,wint rng cnds,rcky mt	ratcliff,hm	1941
NAWTA	20---	568	588	odhe	factrs infl dee, ariz brsh	hanson,wr; mccull	1955
NAWTA	29---	415	431	odhe	rel wintrng dee,phys envrn	loveless,cm	1964
NEXAA	567--	1	32	odhe	ft stanton hrd, ecol, n mx	wood,je; bickle,/	1970
TPCWD	20...	1	124	odhe	ecol charctcs winter range	loveless,cm	1967
WLMOA	20---	1	79	odhe	ceel, doca rnge ecol, mont	mackie,rj	1970
XFWWA	65...	1	15	odhe	wintr mort, utah, fishlake	robinette,wl	1949

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
JWMAA	5---4	427	453	ceel	effect wint brwsng, montan	gaffney,ws	1941
JWMAA	27--3	401	410	ceel	soil stabil requ wint rnge	packer,pe	1963
NAWTA	9----	173	176	ceel	jackson hole, winter, wyom	murier,oj	1944
NAWTA	10---	234	241	ceel	od, meth det nums & range	hunter,gn	1945
SJECA	10...	78	80	ceel	selec elim, earl win, ussr	sobanskii,gg	1979
XFIPA	24---	1	15	ceel	od, probs hab mgt, n fores	lyon,lj	1966

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
BINPA	12...	23	32	alal	moos, mskeg brch, beav env	lulman,pd	1974
CJZOA	45--4	485	490	alal	compar deer yrd, moose yrd	telfer,es	1967
CWRSB	15---	1	27	alal	odvi, behav in snow, fundy	kelsall,jp; presc	1971
JRMGA	16--5	227	231	alal	apprais moose rang, montan	peek,jm	1963
JWMAA	31--3	418	425	alal	od, comp wint rnge, nov sc	telfer,es	1967
JWMAA	34--1	37	46	alal	win ecol, gallatin mt, mon	stevens,dr	1970
JWMAA	34--3	553	559	alal	odvi, wint habitat selectn	telfer,es	1970
JWMAA	40--4	645	657	alal	odvi,hbitat use,symptr rng	kearney,sr; gilbe	1976
NCANA	101--	67	80	alal	distrb, wint habitat, queb	brassard,jm; aud/	1974
NCANA	101--	117	130	alal	biogeog, west n amer, snow	kelsall,jp; telfe	1974
NCANA	101--	131	141	alal	nature of wint habit, shir	peek,jm	1974
NCANA	101--	481	492	alal	snow cond, moose, wolf rel	peterson,ro; alle	1974
PASCC	2----	343	347	alal	wntr rnge prob,susitna val	chatelain,ef	1951
SCNAB	23...	1	5	alal	wint mort, germny, nat pks	burckhardt,d	1957

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
ATICA	12...	158	179	rata	snow, factr in winter ecol	pruitt,wo,jr	1959
ATICA	30...	101	108	rata	feeding sites, snow, alask	laperriere,aj; le	1977
AZOFA	16--4	271	280	rata	numeric snow index, reinde	pruitt,wo,jr	1979
BPURD	1....	324	334	rata	and snow condtns, se maint	stardom,rrp	1975
CAFNA	85--1	39	52	rata	abun forg on win rng, newf	bergerud,at	1971

rata continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
CWRSB	33--1	1	83	rata	invstg carib rnge, nw terr		1975
CWRSB	36---	1	42	rata	taiga wint rnge relns diet	miller,dr	1976
IJBMA	12--1	21	27	rata	wint activ, reltn sno, ice	henshaw,j	1968
OIKSA	25--3	379	387	rata	rel abun food in win, newf	bergerud,at	1974
RIJUA	30---	289	293	rata	intractins w/ habita, alas	klein,dr	1970
SZSLA	21---	109	115	rata	win nutr wld reind in norw	gaare,e	1968
UABPA	1----	324	334	rata	carib and sno cond, se man	stardom,rrp	1975
UABPA	1----	414	419	rata	weath effct on behav, migr	gavin,a	1975
XFWWA	43---	1	48	rata	st matthew isl reind range	klien,dr	1959

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
JWMAA	31--1	159	164	anam	mort, severe wint, n monta	martinka,cj	1967
JWMAA	41--3	560	571	anam	wint behav reln to habitat	bruns,eh	1977
XARRA	148--	1	4	anam	starv, full stomachs, feed	pearson,ha	1969

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
NPMSD	1----	1	161	bibi	bison of yellowstn nat prk	meagher,mm	1973

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
CAFGA	52--2	68	84	ovca	winter obsvtns, sierra nev	mccullogh,dr; sch	1966
CAFNA	87--4	433	454	ovca	chilcotin river bigh popul	demarchi,da; mitc	1973
CWRSB	39---	1	50	ovca	rng ecol in canad ntl prks	stelfox,jg	1976
JWMAA	35--2	257	269	ovca	winter ecology in yellowst	oldemyer,jl; bar/	1971

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
DWINA	44--3	321	325	obmo	arctic survival expert	holmes,f	1969

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
JWMAA	37--3	353	362	oram	forage, habitat pref, alas	hjeljord,o	1973

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
AMZOA	16--4	699	710	many	fat, energy, mammal surviv	young,ra	1976
JWMAA	3---4	295	306	many	yellowst wint rnge studies	grimm,rl	1939
JWMAA	20--2	159	168	many	sno depth, ungu abund, can	edwards,ry	1956
JWMAA	36--4	1068	1076	many	winter foods and range use	constan,kj	1972
JWMAA	42--2	352	361	many	dist brws, sno cov, albrta	telfer,es	1978
JWMAA	43--2	437	444	many	hbitat partitng,fire, mont	singer,fj	1979
NATUA	234--	482	484	many	water, energ turnover, des	macfarlane,wv; h/	1971
QSFRA	8---	79	96	many	eff hiemal envir fac,behav	pichette,c	1973

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
JRMGA	6---1	51	54	dosh	eff graz intens, nutr valu	cook,cw; stoddar/	1953
JRMGA	25--5	346	352	dosh	grz shee on big gm wnt rng	jensen,ch; smith/	1972

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
ZORVA	28...	97	197	caca	winter ecolg, north sweden	markgren,g	1966

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
BINPA	1----	1	176	mamm	snow cover,mamml,bird ecol	formozov,an	1946
ECOLA	46--1	25	34	----	noc thrml bdgt lg,sm trees	turrell,fm; austi	1965
JFUSA	60---	6	9	wldl	wldlife and forest environ	janzen,dh	1962
JRMGA	2---1	53	63	----	meth det util range forage	heady,hf	1949
JRMGA	7---1	14	23	----	applctn ecol, det rnge cnd	parker,kw	1954
JRMGA	10--5	208	212	----	steppoint method, sampling	evans,ra; love,rm	1957
JRMGA	24--1	55	59	----	seas trnds herb, nutr prod	sims,pl; love,rm	1971
JSWCA	25--5	197	198	----	snow fencing, redistr snow	swank,gw; booth,r	1970
JWMAA	19--2	206	214	biga	util wintr brows, biga rng	mcculloch,cy,jr	1955
JWMAA	19--2	215	255	biga	winter browse, se idaho	hoskins,lw; dalke	1955
NAWTA	10---	251	256	biga	b ga-liv compet, west rang	stoddart,la; rasm	1945
TWASA	53...	123	129	wldl	habitat and managed forest	stearns,fw; creed	1964

CHAPTER 17, WORKSHEET 1.4a

Weather profiles during the winter season

Weather profiles for each of the JDAY's from December 24 (JDAY 358) through March 19 (JDAY 78) at 7-day intervals may be completed by referring to the equations below.

SORA: See CHAPTER 14, WORKSHEET 1.1a
ADTC: See CHAPTER 14, WORKSHEET 2.1a - 2.1c
AMXT: See CHAPTER 14, WORKSHEET 2.1b
AMNT: See CHAPTER 14, WORKSHEET 2.1b
QREE: See CHAPTER 14, WORKSHEET 1.2a (complete ADTC first)
RAIN: See CHAPTER 14, WORKSHEET 5.2b
SNOW: See CHAPTER 14, WORKSHEET 5.2b
WIVE: See CHAPTER 14, WORKSHEET 3.2a
(Use Z_o characteristic of snow or vegetation if expressing wind velocity for a selected animal height)

Complete the calculations using equations derived for your local area and tabulate the results below.

					QREE*			PREC		
JDAY	SORA	ADTC	AMXT	AMNT				RAIN	SNOW	WIVE
358	____	____	____	____	____	____	____	____	____	____
1	____	____	____	____	____	____	____	____	____	____
8	____	____	____	____	____	____	____	____	____	____
15	____	____	____	____	____	____	____	____	____	____
22	____	____	____	____	____	____	____	____	____	____
29	____	____	____	____	____	____	____	____	____	____
36	____	____	____	____	____	____	____	____	____	____
43	____	____	____	____	____	____	____	____	____	____
50	____	____	____	____	____	____	____	____	____	____
57	____	____	____	____	____	____	____	____	____	____
64	____	____	____	____	____	____	____	____	____	____
71	____	____	____	____	____	____	____	____	____	____
78	____	____	____	____	____	____	____	____	____	____

*Three blanks are given for different cover types, or for downward, upward and total infrared radiation.

JDAY	SORA	ADTC	AMXT	AMNT	QREE*			PREC		WIVE
								RAIN	SNOW	
358	____	____	____	____	____	____	____	____	____	____
1	____	____	____	____	____	____	____	____	____	____
8	____	____	____	____	____	____	____	____	____	____
15	____	____	____	____	____	____	____	____	____	____
22	____	____	____	____	____	____	____	____	____	____
29	____	____	____	____	____	____	____	____	____	____
36	____	____	____	____	____	____	____	____	____	____
43	____	____	____	____	____	____	____	____	____	____
50	____	____	____	____	____	____	____	____	____	____
57	____	____	____	____	____	____	____	____	____	____
64	____	____	____	____	____	____	____	____	____	____
71	____	____	____	____	____	____	____	____	____	____
78	____	____	____	____	____	____	____	____	____	____

*Three blanks are given for different cover types, or for downward, upward and total infrared radiation.