TOPIC 1. SUSTAINED YIELD

The concept of sustained yield is fundamental to the management of wild ruminant populations. This is a goal to be reached. Some populations have been decimated to the point where sustained yeilds could only be reached after population recovery. Bison are an example of this; the total number of plains bison was but a tiny fraction of their numbers just a few years earlier at one time in their history. Protection allowed for both annual and long-term increases resulting in the build-up of bison herds to levels where sustained yields are now possible, with an annual surplus even.

Sustained yield becomes possible when the population is large enough to buffer short-term effects, but not so large that population crashes occur. Sustained yields are best met when populations have access to adequate supplies of forage and suitable cover throughout the year. The resulting health animals are less subject to diseases than undernourished ones, and well-fed animals that are comparatively free of diseases have good reproductive rates. Thus, sustained yield is first a function of adequate resources and second a function of appropriate harvest levels.

Two time frames are discussed in the next two UNITS; annual production (UNIT 1.1) and long-term production (UNIT 1.2).

UNIT 1.1: ANNUAL PRODUCTION

Maintenance of a stable annual production rate is essential for sustained yields in wild ruminant populations. Considering number alone, the number of births and the number of deaths in a population are equal. This is desirable when the numbers are in balance with the range resources. If the number present is less than the range resources could support, annual production should be positive. If the number present is more than the range resources could support, annual production should be negative.

The balance between natality and mortality rates that result in a stable population may be determined with population prediction techniques described in PART VI, CHAPTER 19, TOPIC 4. Since management can do little in a direct way about natality rates, they are accepted as a biological given and mortality rates are left to be controlled. Mortality rates may be controlled directly by hunting only; all other causes of mortality are under indirect or no control. Car kills, for example, are accepted as facts by states with high deer population, but no state advocates a higher car kill in order to increase total mortality to bring a population down to levels in

line with range resources. Indeed, the opposite is usually done. High winter mortality due to excessive numbers of deer concentrated on too small a forage base often results in attempts to feed the starving deer in order lto reduce mortality. If there are too many deer already, the problem is only compounded if the feeding program is successful. The alternative is to provide adequate harvests in order to prevent excessive winter concentraion areas, resulting in fewer but healthier deer. The reproductive rate is indirectly affected too, as it is higher for healthy animals with higher body weights living on good range compared to those on poor range.

The rapidity with which wild ruminant populations grow is indicated by the successful reintroduction of 21 mountain goats in the Crazy Mountains of Montana in 1941 and 1943 (Lentfer 1955). Ten years later, the population was at least 278, a 13-fold increase, and the annual increase was equal to about one-third of the population. This high growth rate occurred even though the females were not breeding until they were 2 1/2 years old. Such a net rate of annual production must lsoon result in more animals than the forage base could support.

LITERATURE CITED

Lentfer, J. W. 1955. A two-year study of the Rocky Mountain goat in the Crazy Mountains, Montana. J. Wildl. Manage. 19(4):417-429.

REFERENCES, UNIT 1.1

ANNUAL PRODUCTION

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
JWMAA	22--2	141	148	od--	numb, kill, rec use, fores	burcalow,dw; mars	1958

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
CNSVA	22--1	29	31	odvi	hntr tak > 2 deer per sq m	free,s; mccaffrey	1967
NAWTA	4----	549	553	odvi	study, harvst, chequamegon	sanders,rd	1939
NAWTA	6----	332	338	odvi	remov surplus by hunti, pa	mccain,r	1941
NAWTA	16---	472	491	odvi	lack buck law hurt nh hrd?	siegler,hr	1951
NFGJA	10--2	201	214	odvi	mgt impl, trnd, distr kill	severinghaus,cw;/	1963
NYCOA	4---2	22	25	odvi	hunting possib, indicators	severinghaus,cw	1949
NYCOA	7---6	15	15	odvi	deer survival	ny conservat dept	1953
WSCBA	14--9	6	9	odvi	hunters' opinion, any deer	bersing,os	1949
WSCBA	21-12	3	9	odvi	new deal for deer & hunter	keener,jm	1956

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
CAFGA	34--1	25	32	odhe	breed season, produ, calif	chatlin,je	1948
JWMAA	13--4	417	419	odhe	ovca, competition, harvest	halloran,af; kenn	1949
NAWTA	9----	156	161	odhe	productivity, central utah	robinette,wl; ols	1944

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
JFUSA	69-10	736	740	ceel	game prod, harvst in czech	reynolds,hg	1971
NAWTA	23---	491	500	ceel	elk & elk hunting in idaho	mohler,ll; dalke/	1958
NPKMA	26---	118	118	ceel	elk shooting in grnd teton	murie,oj	1952

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
NCANA	101-3	631	642	alal	harvestng program in canad	ritcey,rw	1974
NCANA	101-3	689	704	alal	controlled hunts in quebec	bouchard,r; moisa	1974

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
JWMAA	35--1	71	75	rata	hunt stags in newfoundland	bergerud,at	1971
WMBAA	10---	1	275	rata	prelim invest, barren-gr c	banfield,awf	1954
WMBBA	10---	1	112	rata	life history, ecol, utiliz	banfield,awf	1954

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
				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
JWMAA	19--4	417	429	oram	2-yr stud, crazy mts, mont	lentfer,jw	1955

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
JFUSA	60--1	30	32	----	manip huntng reg, mgt meas	swank,wg	1962
JFUSA	69-10	736	740	game	prodc & harvest, czechoslo	reynolds,hg	1971
NAWTA	6----	362	367	wldl	remov surplus, state admin	barker,es	1941
NAWTA	6----	368	377	game	removng surplus, nat forst	shantz,hl	1941
NAWTA	14---	391	410	wldl	viwpts, open seas, sex, ag	pretrides,ga	1949

CHAPTER 22, WORK SHEET 1.1a

Annual production in relation to variable mortality

Review the arithmetic and exponential population prediction methods described in PART VI, CHAPTER 19, TOPIC 4 and use them in the space below to illustrate the effects of different levels of hunting mortality, winter mortality, and other factors affecting production from one year to the next. In other words, the years ahead with which you wish to predict the number of animals in the population is one (YAPN = 1) in these examples.

UNIT 1.2: LONG-TERM PRODUCTION

Long-term production of wild ruminant populations is maintained by providing adequate range resources. Adequate range resources are provided by the control of animal numbers so plant vigor, primary production, and the floral composition of the range are maintained. Range composition is affected by both the pressure of herbivores foraging and natural succession. Too much foraging pressure results in fewere forage species. Light foraging pressure does not arrest natural succession. In forested areas of the Northeast and the Lake States, succession results in the closing of the forest cnopy, reducing forage available to deer. This results in a switch from abundant summer forage and very productive deer populations to a shortage of summer forage and less productive deer populations in Wisconsin (McCaffery and Creed 1969?).

It may seem a paradox to some, but long-term production of wild ruminants depends on the removal of the number of animals that are surplus in relation to forage resources and breeding potential. One reason it may be hard for some people to understand that apparent paradox is that protection from hunting has resulted in some dramatic success stories. Bison, for example, were nearly extinct. Protection from hunting resulted in the recovery of populations. Pronghorn have a similar history. Even white-tailed deer, a very abundant species now, has benefited by protection from hunting many decades ago.

The point to remember concerning the above success stories is that the populations were decimated by over-hunting, not regulated hunting. Bison were killed for their hides and their tongues, with no restrictions on the numbers killed. Being an animal of the plains, they could be seen from a distance and killed with relatively little effort. Remnant populations survived in the less accessible areas.

The basic concept of long-term production of wild ruminants includes several significant factors. They are adequate annual forage production that can be removed without reducing plant vigor, the metabolic energy in the forage, the metabolic requirements of the animals, and the reproductive and mortality rates of the animals. When these are all in balance, the productivity will be maintained on an energy base.

A WORKSHEET provides a format for some more practice in calculating of carrying capacity. These calculations were first made in PART VI, CHAPTER 20, after the first five PARTS included discussions and WORKSHEETS for calculating weights, ecological metabolism, forage quality and quantity, and population structures.

This is an opportune time to remind readers that all of these components are discussed in detail in earlier PARTS, and the systematic completion of WORKSHEETS in these PARTS will result in formatted data, using weighted means, that make calculations of carrying capacity very simple.

LITERATURE CITED

McCaffery K. R. and W. A. Creed. 1969. Significance of forest openings to deer in northern Wisconsin. Tech. Bull. Number 44, Wisc. Dept. Nat. Res., Madison. 104 p.

REFERENCES, UNIT 1.2

LONG-TERM PRODUCTION

BOOKS

TYPE	PUBL	CITY	PGES	ANIM	KEY WORDS----------	AUTHORS/EDITORS--	YEAR
edbo	uaec	ortn	....	----	env cape thomas reg, alask	us atom energ com	1966

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
AUMGA	47--2	74	79	od--	deer trouble, overpopulatn	cook,db	1945
CAFGA	33--4	287	314	od--	coop study interstate herd	interstat committ	1947
CAFGA	35--2	115	134	od--	3rd rept study interst hrd	interstat committ	1949
CAFGA	36--3	251	284	od--	basic deer management	dasmann,w	1950
JFUSA	70--4	200	203	od--	ecolog framework, deer mgt	short,hl	1972
JRMGA	3---4	280	280	od--	new trends in deer managem	dasmann,w	1951
JWMAA	15--1	27	31	od--	obs, kill, diff syst huntn	westerskov,k	1951
JWMAA	19--1	143	147	od--	theoret framewrk, mgt prob	thomas,dw; pasto,	1955
JWMAA	31--4	667	679	od--	dynam programmng, mgt plan	davis,ls	1967
NAWTA	26---	448	459	od--	on the bad river reservatn	cook,rs; hale,jb	1961
NAWTA	34---	372	387	od--	ceel, optimum yield popula	gross,je	1969

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
AUMGA	54--2	76	81	odvi	key deer: challeng fr past	allen,rp	1952
CNSVA	17--2	2	4	odvi	future for deer in nw york	severinghaus,cw	1962
CNSVA	31...	18	19	odvi	philosophy of deer managem	severinghaus,cw;/	1976
NFGJA	10--201		B214	odvi	trend, distr of legal kill	severinghaus,cw;/	1963
PCGFA	17---	9	13	odvi	the sylamore deer study	crawford,hs; leon	1963
TNWSD	1----	358	364	odvi	results of deer management	severinghaus,cw	1958
TNWSD	30---	143	148	odvi	mgt implic,huntr attitudes	haulsee,hv; bell/	1973
VIWIA	7---5	6	....	odvi	the white-tailed deer	woolley,dj	1946
VIWIA	10-12	18	20	odvi	whitetail makes a comeback	engle,jw	1949
VIWIA	12--5	22	24	odvi	problems of deer herd mgmt	engle,jw,jr	1951
VIWIA	16--9	5-7	22	odvi	a report on the glades dee	davey,sp	1955

odvi continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
VIWIA	19-12	8	9	odvi	comp indian-killd w/ modrn	mcginnes,bs; reev	1958
VIWIA	20--8	5	7	odvi	virginia deer mgmt program	davey,sp	1959
VJSCA	13--1	1	16	odvi	alleghany county, va, herd	giles,rh,jr; gwyn	1962
WSCBA	4---2	8	27	odvi	the problem of managng dee	swift,e	1939
WSCBA	22--8	6	10	odvi	the deer unit, survey, mgt	keener,jm; thomps	1957
XENCA	39---	1	34	odvi	in the midwest; a symposiu	usda forest servi	1970
XFWWA	112--	1	46	odvi	sel refs on mgt, 1910-1966	hosley,nw	1968

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
AZWBA	3----	1	109	odhe	in ariz chaparr, anal hrds	swank,wg	1958
AZWBA	7----	1	195	odhe	kaibab hrd; his, prob, mgt	russo,jp	1964
CAFGA	33--4	287	314	odhe	coop study interstate herd	interstat committ	1947
CAFGA	35--2	115	134	odhe	3rd rept study interst hrd	interstat committ	1949
CAFGA	36--3	251	284	odhe	basic deer management	dasmann,w	1950
CAFGA	37--3	233	272	odhe	the devil's gardn deer hrd	interst committee	1951
CFGGA	8----	1	163	odhe	life hist & mgt, cal coast	taber,rd; dasmann	1958
JWMAA	10--1	54	59	odhe	management of black-tail d	einarsen,as	1946
JWMAA	34--4	852	862	odhe	resp mgt summ rnge, kaibab	hungerford,cr	1970
NAWTA	7----	391	397	odhe	herd management of mule de	mitchell,ge	1942
NAWTA	12---	204	210	odhe	ceel, plan mgt progr, west	rasmussen,di; dom	1947

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
JOMAA	26--2	114	119	ceel	partl history of hrd, colo	swift,lw	1945
JRMGA	3---4	279	280	ceel	elk management problems	cooney,rf	1951
JRMGA	5---1	3	7	ceel	elk problems in montana	cooney,rf	1952
NAWTA	7----	375	379	ceel	managing nebo's wapiti	olsen,o	1942
NAWTA	13---	401	406	ceel	yakima rocky mntn elk herd	mitchell,ge; lauck	1948
NAWTA	34---	372	386	ceel	od, opt yield in populatns	gross,je	1969
NPKMA	27---	33	34	ceel	california's tule elk	anonymous	1953
NPKMA	27---	56	57	ceel	teton's elk problem contin	murie,oj	1953
NTRLA	10--2	30	39	ceel	future of yellowston wapit	kittams,wh	1959

ceel continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
WGFBA	10---	1	184	ceel	elk of jackson hol; studie	anderson,cc	1958
WLMOA	16---	1	49	ceel	stat, ecol roosev elk, cal	harper,ja; harn,/	1967
WSCBA	9---4	6	10	ceel	wisconsin's elk herd	reese,sw	1944

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
HEREA	85--2	157	162	alal	genetic implic manag polic	ryman,n; beckman/	1977
NAWTA	14---	492	501	alal	status of moose in n ameri	hatter,j	1949
NAWTA	16---	461	470	alal	future of isle royale herd	krefting,lw	1951
NAWTA	18---	539	552	alal	progress in mgt, s c alask	spencer,dl; chate	1953
NAWTA	18---	563	579	alal	newfoundland moose	pimlott,dh	1953
NCANA	101-1	1	8	alal	moose yestrdy, tody, tomor	peterson,rl	1974
NCANA	101-1	643	656	alal	manag, conif ecotone, n am	karns,pd; haswel/	1974
PASCC	3----	134	136	alal	distrib & abundan in alask	chatelain,ef	1954
TWASA	45---	1	10	alal	the moose in early wiscons	schorger,aw	1957
XFWLA	312--	1	51	alal	the moose and its ecology	hosley,nw	1949

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
APLCA	35--2	299	300	rata	caribou on katahdin, maine	rogers,la	1964
CAUDA	25--5	144	149	rata	bar-grnd carib & managemnt	kelsall,jp	1963
JOMAA	39--4	560	573	rata	prelim study of ungava car	banfield,awf; ten	1958
NAWTA	1----	416	419	rata	the minnesota caribou herd	swanson,g	1936
NAWTA	14---	477	491	rata	present status of, n ameri	banfield,awf	1949
ORYXA	4---1	5	20	rata	plight of barrn-grnd carib	banfield,awf	1957
SALKA	27---	240	241	rata	porcupine herd mgmnt needs	jakimchuk,rd	1976
SYLVA	4---1	17	23	rata	status wdland carib, ontar	de vos,a	1948
TNWSD	1----	123		rata	canad carib researc progrm	banfield,awf	1958
TNWSD	1----	201	207	rata	the caribo of gaspe, canad	gaston,m	1958
WMBAA	10---	1	79	rata	distrib, migration, status	banfield,awf	1954
WMBAA	12---	1	148	rata	continued barre gr studies	kelsall,jp	1957

rata continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
WMBAA	15---	1	145	rata	coop studies of barrn-grnd	kelsall,jp	1960
XIWFA	54---	1	93	rata	alaska-yukon caribou	murie,oj	1935

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
AMNAA	43--2	257	354	anam	life hist, ecol, range use	buechner,hk	1950
CAFGA	30--4	221	241	anam	prong-hornd antel in calif	mclean,dd	1944
JOMAA	25--1	43	46	anam	distri & status in montana	beer,j	1944
JOMAA	38--3	423	423	anam	note on the sonoran prnghn	halloran,af	1957
NAWTA	1----	652	655	anam	prng-hrnd antel in the s w	taylor,wp	1936
NAWTA	3----	381	387	anam	life hist & managmnt, oreg	einarsen,as	1938
NMCBA	106--	1	34	anam	the 1945 status in canada	rand,al	1947

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
AIWHA	15--3	112	115	bibi	return of the bison	lewis,m	1973
AMFOA	50-10	472	475	bibi	buffalo. wild or tame?	cahalane,vh	1944
ANKIA	60--5	130	134	bibi	buffalo returned to plains	halloran,af	1957
ECMOA	11--4	347	412	bibi	history, range & home life	soper,jd	1941
ORYXA	7---6	305	314	bibi	canad; save fr extinc, mgt	egerton,pjm	1964
PSDAA	41---	41	43	bibi	bison occidentalis, s dako	galbreath,ec; ste	1962
TRVIA	108-2	286	304	bibi	ecol and mangmnt, amer bis	fuller,wa	1961
XFWLA	212--	1	8	bibi	care of buffaloes	anonymous	1942

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
AMNAA	56--2	297	324	ovca	ecology of the mountn shee	mccann,lj	1956
ANKIA	59--1	2	10	ovca	future of the bighorn shee	buechner,hk	1956
AUMGA	49--6	332	337	ovca	bighorns on the border	halloran,af	1947

ovca continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
IGWBA	1----	1	154	ovca	statu, lif hist, mgt, idah	smith,dr	1954
JOMAA	25--4	364	367	ovca	hist, statu in s c new mex	halloran,af	1944
NAWTA	1----	641	643	ovca	status of sierra bighorn s	dixon,js	1936
NAWTA	14---	527	536	ovca	desert bighorn management	halloran,af	1949
NPKMA	38---	10	11	ovca	unpredictabl nelson bighor	wauer,rh	1964
WLMOA	4----	1	174	ovca	in us; past, presen, futur	buechner,hk	1960

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR

ovda

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
AMFOA	47--8	368	372	obmo	the return of the musk oxe	young,sp	1941
AMFOA	47--9	424	....	obmo	canada's fight for musk ox	yarham,er	1941
ATICA	16--4	275	276	obmo	observ, banks isl, nw terr	maher,wj; holmes,	1963
AUMGA	58--4	262	265	obmo	retrn of vanish m ox, pt I	jackson,hht	1956
AUMGA	59--1	26	29	obmo	retrn of vansh m ox, pt II	jackson,hht	1957
JOMAA	45--1	1	11	obmo	in jameson & scorsby land	hall,ab	1964
MAMLA	22--1	168	174	obmo	the musk ox in eas greenld	vibe,c	1958
NAWTA	19---	504	510	obmo	facts about canad musk-oxe	tener,js	1954
NTCNB	1---3	20	21	obmo	the retrn of the shaggy ox	smith,p; jonkel,c	1972
ORYXA	2---2	76	86	obmo	muskox (ovibos moschatus)	glover,r	1953
TNWSD	15...	123	....	obmo	biolog vigor & the musk ox	teal,jh,jr	1958
WMBAA	9----	1	34	obmo	prelim stud, ellesmere isl	tener,js	1954

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
IGWBA	2----	1	142	oram	life hist & mgmnt in idaho	brandborg,sm	1955
NAWTA	34---	409	418	oram	the mountain goat in color	hibbs,d; glover,/	1969

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
JWMAA	35--4	644	657	biga	computr mgt game, brit col	walters,cj; bunne	1971
JWMAA	36--1	119	128	biga	manag plans, simul modelin	walters,cj; gross	1972
JWMAA	36--1	128	134	biga	periodc harv,increas yield	walters,cj; bandy	1972
MAMLA	22--2	317	322	ungu	conservatn & the ungulates	darling,ff	1958
NAWTA	12---	293	320	ungu	new techniques, hoof mamml	taylor,wp	1947
NAWTA	14---	538	543	biga	the big-game resource	mitchell,ge	1949
NAWTA	17---	437	447	biga	applic practi mgt techniqs	hunter,gn	1952
NAWTA	22---	544	569	biga	eff huntng controllng pops	longhurst,wm	1957

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
JOMAA	28--4	333	342	bibo	the wisent or european bis	glover,r	1947
JOMAA	29--3	300	301	bibo	furth note on europ wisent	munns,en	1948

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Bannerman, M. M. and K. L. Blaxter (Eds.). 1969. The husbanding of red deer; proceedings of a conference held at the Rowett Institute, Aberdeen, Jan., 1969, Aberdeen, Rowett Research Institute and the Highlands and Islands Develop. Board. 79 p.

CHAPTER 12 - WORKSHEET 1.2a

Calculation of energy balances and numbers for long-term production

This simplified WORKSHEET calls attention to the factors needed for calculations of energy balances and numbers for long-term production of wild ruminants.

Answer the following questions by reviewing the TOPICS and UNITS listed from other CHAPTERS, determining the appropriate numbers, and making the appropriate calculations.

Annual forage production? (See PART IV, CHAPTER 13, TOPICS 1 & 2)

Forage available? (See PART IV, CHAPTER 13, TOPICS 1 & 2)

Forage required? (See PART IV, CHAPTER 12, TOPIC 3)

Reproductive and mortality rates? (See PART VI, CHAPTER 19, TOPICS 1 & 2)

Factors affecting population growth? (See PART VI, CHAPTER 19, TOPIC 5)

Combination of natality and mortality required to stablize number? (See PART VI, CHAPTER 19, TOPIC 4)

Need further review of carrying capacity calculations? (See PART VI, CHAPTER 20, TOPIC 1)

The use of weighted mean procedures for calculating diet and population characteristics greatly simplifies the calculations here. Careful attention to and completion of the WORKSHEETS in PARTS I - VI will make the above calculations relatively easy.

UNIT 1.3: SYMPATRIC USE OF RANGE

The sympatric use of range may be beneficial or detrimental to both animal and range, depending on the stocking levels. Differences in behavior (See PART II) and in food habits (See PART IV) result in different amounts of overlap in the use of space and forage resources. When overlap is great and competition is intense, the sympatric use of range results in deterioraation of the range, loss of condition of the animals competing for limited resources, and drops in productivity.

When ecologically appropriate levels of sympatric use are occurring, more efficient use is made of range resources. Differences in the timing of activities reduce competition for space. Differences in food habits reduce competition for forage. Since light grazing and browsing stimulate forage production, total range production is higher under diversified foraging than single-species foraging.

Sympatric use of the range may result in disease problems. This has been a concern of cattlemen in relation to elk and bison, for example. The literature on parasites and diseases is listed in PART III, CHAPTER 10, TOPIC 1.

The question of whether wild: wild or wild: domestic ruminants compete is not a simple one, nor may it be answered "yes or no." It is another example of a gradient-type question, and must be treated as such if the answers to the question are to be ecologically reasonable.

REFERENCES, UNIT 1.3

SYMPATRIC USE OF RANGE

BOOKS

TYPE	PUBL	CITY	PGES	ANIM	KEY WORDS	AUTHORS/EDITORS	YEAR
aubo	stac	hapa	668	odhe	lvstck, compar forag utili	williamson,c	1956
edbo	uwyp	lawy	294	ceel	n amer elk: ecol, beh, mgt	boyce,ms; hayden-	1979

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
FOSCA	1---2	130	139	od--	doca, range relations, uta	julander,o	1955
HILGA	47...	191	247	od--	dosh, food relatns, califo	longhurst,wm; co/	1979
JFUSA	48--6	410	415	od--	doca,range relations, utah	julander,o; robin	1950
JRMGA	2---4	206	212	od--	lvstck wint forag stud,cal	dasmann,w	1949
JWMAA	42--1	101	107	od--	forag relns,2 dee spec, tx	krausman,pr	1978
UAECA	121--	3	17	od--	deer mgt,range lvstck prod	stoddart,la; rasm	1945

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
AMNAA	31--3	697	743	odvi	rang veg rel to lvstck,tex	buechner,hk	1944
JWMAA	32--3	558	565	odvi	odhe, habitat relns, monta	martinka,cj	1968

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
CGFPA	21---	1	20	odhe	doca, sagebr, use wint ran	anderson,ae	1969
JWMAA	39--3	605	616	odhe	doca, range relns, prairie	dusek,gl	1975
JWMAA	13--4	421	423	odhe	lvstck, eff on range, utah	smith,ad	1949
WLMOA	20---	1	79	odhe	ceel, doca, rang ecol, rel	mackie,rj	1970
JRMGA	30--2	110	116	odhe	lvstck rel,ldgpl pine,oreg	stuth,jw; winward	1977

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
JRMGA	28--1	43	47	ceel	od,doca,diet overlap, colo	hansen,rm; reid,l	1975
JRMGA	28--2	120	125	ceel	doca,imprv wnt for by graz	anderson,ew; sche	1975
JWMAA	30--2	349	363	ceel	livstk, rang rels, montana	stevens,dr	1966
NAWTA	14---	513	526	ceel	lvstck, rang carry-capacit	rasmussen,di	1949
WMBAA	19---	1	62	ceel	doca,rng rel,ridng mt n pk	blood,da	1966

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
JWMAA	39--4	653	662	alal	od, relatns, burn,n e minn	irwin,ll	1975

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
JWMAA	40--1	151	162	rata obmo	summer rng relns,nwt	wilkinson,pf; sh/	1976

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
JANSA	40--5	985	992	anam	antlop, lvstck, rangelands	yoakum,jd	1975
TRVIA	1961-	266	285	anam	lvstck,reg numbrs,land use	buechner,hk	1961

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
JWMAA	13--4	417	418	ovca	od, food relns, s new mexi	halloran,af	1949
tdbca	8----	29	36	ovca	relns,feral burros,blk mts	mcmichael,tj	1964

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
JWMAA	40--1	151	162	obmo	rata, summer rng relns,nwt	wilkinson,pf; sh/	1976

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
JRMGA	28--1	43	47		many diet overlap, s colorado	hansen,rm; reid,l	1975
JRMGA	30--1	17	20		many food rels, red desrt, wyom	olsen,fw; hansen,	1977
NAWTA	29---	404	414		many range rels, summr rng,utah	julander,o; jeffe	1964

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
JRMGA	25--5	346	352	biga	dosh,guidelnes,grazng,wntr	jensen,ch; smith/	1972
XFRMA	4----	1	16		vert habitat relations of verte	reynolds,hg; john	1964

OTHER PUBLICATIONS

Capp, J. C. 1968. Bighorn sheep, elk, mule deer range relationships/a review of literature including a brief history of bighorn sheep in Rocky Mountain National Park, Colorado. Rocky Mt. Nature Assoc. and Colo. State Univ. 75 p.