PART VII. THE MANAGEMENT OF WILD RUMINANTS

Wild ruminants are a most important group of game animals on the North American continent. The number of field and laboratory studies of wild ruminants and their habitats must surely exceed that of any other group of wild species. Because so much is known about them, a scientific approach to management is possible, based on sound biological knowledge.

Why, if so much is known about wild ruminants, is management often such a controversial subject? Because there is a considerable emotional attachment to them--especially to deer--by many segments of the public. These attachments include a very strong love of the hunt at one extreme and an equally strong, completely protective, love of the hunted at the other extreme.

It is easy to be so intent on current problems that time is not made available to put all our knowledge and understanding together. Each study of some particular facet of wild ruminant biology, such as behavior, reproduction, habitat conditions, or range use becomes almost an entity by itself. Sometimes the findings appear to be applicable only to relatively small geographical areas or to special conditions. There are many basic biological functions that are common to different species and their habitats, however. Only the numerical values representing these functions differ between species and areas.

So many aspects of human endeavor have been advancing in the decades of the 60's and 70's, and the management of wild ruminants should be no different. Scientific management must focus on the animal-environment relationships if we are to be professionally competent, both in biology and technology, for animal and environment are interrelated and are inseparable.

PARTS I through VI have brought information together on the fundamental biology of wild ruminants and PART VII brings information and references together to produce a picture of where we are in their management. Some of that information may appear complicated, and many of the details are. They must be presented and used, however, because these details occur within a framework of basic ecological laws, laws of nature that man cannot repeal.

No system of management will result in long-term success if basic ecological laws are ignored. Scientific management should include options which are best described as ecological alternatives, and from these alternatives one chooses what one <u>wants</u> to do. The "demands" of special interest groups for saving all deer, for outlawing hunting, for unrealistic season dates, or any other wish or desire of an individual or group should be scrutinized in relation to ecological alternatives, and ecologically unrealistic ones rejected. Further, it must be made abundantly clear why such demands are not within the realm of ecological alternatives.

Since the wants of different segments of society are often contradictory, compromises between the best course of action and a less desirable course may be necessary. This is acceptable if such compromises are within the limits of ecological alternatives.

Deer, elk, moose, and other ruminants are poor politicians; they do not understand the will of the people. They relate to their environment at a fundamental, functional level, and if it is the wish of the people to make a housing development out of a forested area, the animals will react according to basic instincts and move out, with no understanding of the intentions and good will of the people who move there.

The five CHAPTERS in this PART VII emphasize habitats and people. Management of wild ruminant habitats is discussed in CHAPTER 21. Biologically-based species management is discussed in CHAPTER 22. Improper range use is discussed in CHAPTER 23. Sociological and economic considerations are discussed in CHAPTER 24; this CHAPTER should be the subject of a book by a farsighted and broadly-educated author. Research needs--a chance for me to speculate and philosophize--are discussed in CHAPTER 25.

The last of 7 PARTS, it is my wish that each of you will recognize the roles of and use the first 6 PARTS in your management deliberations, whether in the classroom or the research and management office of your state or province.

GLOSSARY OF ANIMAL CODE NAMES

Wild ruminants are referred to in this PART by a 4-character abbreviation from the family, genus and genus-species. These are listed below under Abbreviation.

Scientific names of North American wild ruminants are those used in BIG GAME OF NORTH AMERICA, edited by J.C. Schmidt and D. L. Gilbert (1979: Stackpole Books, Harrisburg, PA 17105, 494 p.), and may be different from the scientific names given in the original literature.

The abbreviations used for North American wild ruminants are listed below.

CLASS: MAMMALIA

ORDER: ARTIODACTYLA	Abbreviation
FAMILY: CERVIDAE	cerv
GENUS: *Odocoileus* (deer)	od--
SPECIES: *O. virginianus* (white-tailed deer)	odvi
O. hemionus (mule deer)	odhe
GENUS: *Cervus* (Wapiti, elk)	ce--
SPECIES: *C. elaphus*	ceel
GENUS: *Alces* (moose)	
SPECIES: *A. alces*	alal
GENUS: *Rangifer* (caribou)	
SPECIES: *R. tarandus*	rata
FAMILY: ANTILOCAPRIDAE	
GENUS: *Antilocapra*	
SPECIES: *A. americana* (pronghorn)	anam
FAMILY: BOVIDAE	bovi
GENUS: *Bison* (bison)	bi--
SPECIES: *B. bison*	bibi
GENUS: *Ovis* (sheep)	ov--
SPECIES: *O. canadensis* (bighorn sheep)	ovca
O. dalli (Dall's sheep)	ovda
GENUS: *Ovibos*	
SPECIES: *O. moschatus* (muskox)	obmo
GENUS: *Oreamnos*	
SPECIES: *O. americanus* (mountain goat)	oram

The abbreviations used for European wild ruminants are listed below.

CLASS: MAMMALIA

ORDER: ARTIODACTYLA	Abbreviation
FAMILY: CERVIDAE	cerv
GENUS: Capreolus (roe deer)	ca--
SPECIES: C. capreolus	caca
GENUS: Dama (fallow deer)	da--
SPECIES: D. dama	dada
GENUS: Cervus (Wapiti, elk)	ce--
SPECIES: C. elaphus (red deer)	ceel
GENUS: Alces (moose)	
SPECIES: A. alces	alal
GENUS: Rangifer (caribou)	
SPECIES: R. tarandus	rata
FAMILY: BOVIDAE	
GENUS: Bison (bison)	
SPECIES: B. bonasus	bibo
GENUS: Capra (ibex, wild goat)	cp--
SPECIES: C. aegagrus (Persian ibex)	cpae
C. siberica (Siberian ibex)	cpsi

OTHERS

Abbreviations for a few other species and groups of species may appear in the reference lists. These are listed below.

Axis axis (axis deer)	axax
Elaphurus davidianus (Pere David's deer)	elda
Cervus nippon (Sika deer)	ceni
Hydropotes inermis (Chinese water deer)	hyin
Muntiacus muntjac (Indian muntjac)	mumu
Moschus moschiferus (musk deer)	momo
Ovis nivicola (snow sheep)	ovni
Ovis musimon (moufflon)	ovmu
Ovis linnaeus (Iranian sheep)	ovli
Rupicapra rupicapra (chamois)	ruru
big game	biga
domestic sheep	dosh
domestic cattle	doca
domestic goat	dogo
domestic ruminant	doru
herbivore	hrbv
mammals	mamm
three or more species of wild ruminants	many
ruminants	rumi
ungulates	ungu
vertebrates	vert
wildlife	wldl
wild ruminant	wiru

ORGANIZATION OF REFERENCE LISTS

Extensive reference lists, based on computer-assisted searches back to 1970 and manual searches of literature published prior to 1970, are included in each of the PARTS. The lists are organized in a functional way for use in the library rather than in the conventional alpabetized-by-author way, with the information necessary for locating the references in libraries given in abbreviated, one-line form. The reference books listed after each PART, CHAPTER, and TOPIC contain background information for the material covered, and may contain specific information for several of the UNITS and WORKSHEETS.

The headings for the lists of BOOKS are:

TYPE PUBL CITY PGES ANIM KEY WORDS----------------- AUTHORS/EDITORS-- YEAR

The TYPE of book could have either an author (aubo) or an editor (edbo). Publishers (PUBL) and CITY of publication are given with four-letter mnemonic symbols defined in the GLOSSARY. The PAGE column gives the number of pages in the book; ANIM refers to the species discussed in the book (given as a four-letter abbreviation of genus and species), and KEY WORDS lists key words from the title. The AUTHORS/EDITORS' names and YEAR of publication are given in the last two columns. Thus all of the essential information for finding each book in the library is given on just one line.

Serial publications that pertain to each division are listed with a slightly different format. (Serials are identified by a five-character, generally mnemonic code called CODEN, published in 1977 BIOSIS, LIST OF SERIALS (BioSciences Information Service, 2100 Arch Street, Philadelphia, PA 19103).

The headings for the lists of SERIALS are:

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

The volume and issue numbers (VO-NU) are given after the CODEN entry, followed by beginning page (BEPA), ending page (ENPA), species discussed (ANIM), key words from the title (KEY WORDS), AUTHORS, and YEAR.

Specific authors and dates of publication can be located quickly by scanning the two right-hand columns. If the author's name fits in the 17 characters, some character spaces are left blank. If there are two authors and all of the first author's name and part of the second author's name fits in the 17 character spaces, the second author's name is truncated at the right margin of the author column. If there are more authors that do not appear in the author column due to lack of space, a slash (/) is added inthe 17th space of the column.

References cited in the text material and in the WORKSHEETS are given under LITERATURE CITED in the traditional format (author, date, title of article, journal, volume, issue number, and page numbers).

A third category, OTHER PUBLICATIONS, may be included at the beginning of PARTS or in the CHAPTERS. This category contains references to publications that are not authored or edited books or serials listed by BioSciences Information Service. Examples are "Transactions of the Northeastern Deer Study Group Meetings" and "Biannual Pronghorn Antelope Workshop, Proceedings." Both of these contain many articles on deer and pronghorns, respectively, but are not included in the one-line abbreviated form. Such publications are listed by titles, which should make it possible to locate the publications in libraries.

HOW TO USE THIS SYSTEM

The one-line format used to list references makes it possible to list several thousand references in a minimum amount of space. The logic of the one-line entries in the reference lists is based on the order of decision-making when finding literature. First, the references are grouped according to biological functions and relationships discussed in this book. Second, species of interest are selected. Third, journals containing references to be read are located in the library. Fourth, the publications are located in the journals. The use of this reference list format in the library will confirm the logic of this arrangement. Call numbers and stack levels should be added in the margins so references may be quickly located in a particular library.

CODEN entries are identified by the full title of the serial publication and its country, territory, or commonwealth of origin in the APPENDIX. CODEN entries in the serial lists are alphabetized. This results in some of the full titles being out of alphabetical order. Since the user of this book will usually work from CODEN to consult the list of full titles in the APPENDIX, this disorder will result in nothing more than occasional inconvenience. Most of the full titles will be near alphabetized, so the CODEN for a specific serial can be quickly found by scanning the appropriate part of the list.

Serials, including journals and report literature, constitute the major portion of the literature on wild ruminants. Scientists are urged to publish their findings in recognized journals so the results of their work are readily available.

REFERENCES, PART VII

THE MANAGEMENT OF WILD RUMINANTS

BOOKS

TYPE	PUBL	CITY	PGES	ANIM	KEY WORDS------------------	AUTHORS/EDITORS--	YEAR
aubo	fost	nyny	426	cerv	antlope, deer of n america	caton,jd	1877
aubo	rokp	loen	597	cerv	deer of g. britain, irelan	whitehead,gk	1964
aubo	huho	nyny	426	od--	deer, antelope of america	caton,jd	1877
edbo	stac	hapa	668	od--	deer of north america	taylor,wp	1956
aubo	stac	hapa	128	od--	if deer are to survive	dasmann,w	1971
aubo	vipr	nyny	194	od--	deer of the world	whitehead,gk	1972
aubo	omcc	eail	107	odvi	the white-tailed deer	madson,j	1961
edbo	nhfg	conh	256	odvi	the white-tai deer, new ha	siegler,hr	1968
aubo	ucap	beca	567	odhe	a herd of mule deer	linsdale,jm; tomi	1953
edbo	unbp	line	605	odhe	mule, black-tailed, no ame	wallmo,oc	1981
aubo	oxup	loen	215	ceel	herd, red deer,stud, behav	darling,ff	1937
aubo	stac	hapa	386	ceel	elk of north america	murie,oj	1959
aubo	wiwe	eail	125	ceel	the elk	madson,j	1966
aubo	ucap	beca	209	ceel	tule elk	mccullough,dr	1971
aubo	cite	oxen	74	ceel	ecology of red deer	mitchell,b; stai/	1977
edbo	wimi	wadc	....	ceel	ecology and management	thomas,jw; towei	INPR
aubo	uwyp	lawy	294	ceel	n amer elk: ecol,behav,mgt	boyce,ms; hayden-	1979
aubo	utop	toon	280	alal	north american moose	peterson,rl	1955
aubo	macm	nyny	300	rata	bar-gr car of north canada	pike,w	1892
aubo	ukap	laka	163	rata	bar-ground carib, keewatin	harper,f	1955
aubo	qupr	oton	339	rata	migratory, barren-ground c	kelsall,jp	1968
aubo	stac	hapa	238	anam	prnghrn antlp & its mngmnt	einarsen,a	1948
aubo	stac	hapa	225	anam	hunting pronghorn antelope	popowski,b	1959
aubo	rowa	loen	....	bovi	wild oxen, sheep, goats of	lydekker,r	1898
aubo	utop	toon	991	bibi	n amer buffalo, wild state	roe,fg	1970
aubo	thcr	nyny	242	bibi	the buffalo	haines,f	1970
aubo	aakn	nyny	339	bibi	the time of the buffalo	mchugh,t	1972
aubo	swap	atoh	374	bibi	the buffalo book, saga ani	dary,d	1974
aubo	ucap	beca	316	bibi	n amer bison, evol, classi	mcdonald,jn	1981
aubo	uopr	nook	247	ov--	great ark of the wld sheep	clark,jl	1964
aubo	uchp	chil	383	ov--	mt sheep, behavior, evolut	geist,v	1971
aubo	coup	itny	248	ov--	mt sheep, man, norther wil	geist,v	1975

TYPE	PUBL	CITY	PGES	KEY WORDS----------------------	AUTHORS EDITORS--	YEAR
aubo	uchp	chil	383	ovca mount sheep: behavi, evolu	geist,v	1971
aubo	usgp	wadc	242	ovca the bighorn of death valley	welles,re; welle	1961
aubo	qupr	oton	166	obmo muskoxen in canada	tener,js	1965
aubo	haho	nyny	85	obmo oomingmak, expedi, nunivak	matthiessen,p	1967
aubo	doup	nyny	318	many americ anim; popular guide	stone,w; cram,we	1902
aubo	cscs	nyny	347	many our big game	huntington,d	1904
aubo	cscs	nyny	1267	many life hist northern animals	seton,et	1909
aubo	ropr	nyny	129	many wildlife in alaska, ecolog	leopold,as; darli	1953
edbo	holt	nyny	264	many records of n a big game an	boone & crockett	1958
aubo	ropr	nyny	547	many mammals of north america	hall,er; kelson,k	1959
aubo	ucap	beca	586	many wildlife of mexico	leopold,as	1959
aubo	vipr	nyny	304	many wildlife in america	matthiessen,p	1959
aubo	repu	nyny	335	many principals of mammalogy	davis,de; golley,	1963
aubo	blsp	loen	308	many guide, study of productivi	golley,fb; buechn	1968
aubo	jhpr	bamd	769	many mammals of the world	walker,ep; paradi	1968
aubo	whfr	sfca	458	many wildlife ecology	moen,an	1973
aubo	utop	toon	438	many the mammals of canada	banfield, awf	1974
edbo	iucn	mosw	940	many behav & its rela to mngmnt	geist,v; walther,	1974
aubo	dalt	laen	271	dada fal de: histor, distr, bio	chapman,d; chapma	1975
aubo	repu	nyny	1023	dome bioenergetics and growth	brody,s	1945
edbo	coup	itny	1463	dome duke's physiol domest anim	swenson,mj	1970
aubo	acpr	nyny	202	ungu reproductive behav, ungula	fraser,af	1968

THE BIOLOGY AND MANAGEMENT OF WILD RUMINANTS

CHAPTER TWENTY-ONE

MANAGEMENT OF WILD RUMINANT HABITATS

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

First printing, March 1982

Library of Congress Card Catalog Number 80-70984

CONTENTS OF CHAPTER TWENTY-ONE

MANAGEMENT OF WILD RUMINANT HABITATS

CONTENTS continued on the next page

CHAPTER 21. MANAGEMENT OF WILD RUMINANT HABITATS

Wildlife management has been, at times, considered a misnomer, or at least an innappropriate term in relation to what can be done by "wildlife managers." What can wildlife managers manage? Wildlife, wildlife habitats, and people. Wildlife may be the least manageable of the three, wildlife habitats next, and people the most manageable.

The first twenty CHAPTERS have emphasized the biological characteristics of wild ruminants and their habitats. While wild ruminants are not "managed" as domestic ruminants are, knowledge of their basic biological characteristics is essential before they, their habitats, or people who use the resource can be managed wisely. Thus the biological foundation was laid. And what happens if these three--wild ruminants, their habitats, and people--are managed wisely? If management results in increased production of habitat resources, the carrying capacity of an area has been increased.

The concept of carrying capacity was discussed in the INTRODUCTION to this entire 7-part series, PART I, and again in PART VI. Population dynamics and predictions of ruminant populations at different rates of growth were illustrated in CHAPTER 19. Calculations of carrying capacity were illustrated in CHAPTER 20. Evaluations of these calculations result in the inevitable conclusion that population requirements may exceed range resources available. Then, the number of animals must be reduced, range resources increased, or both. It is the second alternative--range resources increased--that is discussed in this CHAPTER 21.

Conditions change in both time and space. Since both population requirements and range resources are variable through the year and from year to year, simple alternatives to management problems seldom exist.

You have been introduced in the previous six PARTS to changes in animal characteristics, and now is the time to begin relating these basic biological characteristics to management problems. Electronic calculations have been emphasized. Calculators do not think, but they do make very rapid computations. You do the thinking about wild ruminants and their habitats, formulate the numerical expressions of the ecological relationships between the two, and let electronic computing equipment make the calculations with speed and accuracy.

The four TOPICS in this CHAPTER arranged in a sequence beginning with the most arbitrary areas on which management may be done (TOPIC 1. POLITICALLY-DEFINED AREAS), then more specific areas (TOPIC 2. HABITAT MANAGEMENT AREAS), followed by specific practices that may be used to manage habitat (TOPIC 3. HABITAT MANAGEMENT PRACTICES) and concluding with the most specific management of wildlife habitats, that of agrticulture and forestry (TOPIC 4. COMMERCIAL PRIORITIES).

These TOPICS are chosen in part because of the way the literature on management may be identified. Titles of research papers describing management practices often refer to a state or province (TOPIC 1), or refuges, preserves, parks, national forests . . . (Topic 2), specific management practices (TOPIC 3), and to the effects of agriculture and forestry on habitats (TOPIC 4). Many of the articles contain information on all of these TOPICS; it is best to look over the SERIAL lists after each UNIT when searching for literature on habitat management.

REFERENCES, CHAPTER 21

MANAGEMENT OF WILD RUMINANT HABITATS

BOOKS

TYPE	PUBL	CITY	PGES	ANIM	KEY WORDS-----------------	AUTHORS/EDITORS--	YEAR
aubo	yaup	nhct	240	----	wildl cons, theory, practi	hornaday,wt	1914
aubo	gbri	nyny	292	----	thirty years war for wldlf	hornaday,wt	1931
aubo	cscs	nyny	481	----	game management	leopold,a	1933
aubo	cnpc	apwi	208	----	conserv, renewable resourc	dahlberg,em	1939
edbo	cscs	nyny	365	----	the way of game abundance	grange,wb	1949
aubo	jwis	nyny	570	----	rang man, principl, practi	sampson,aw	1952
aubo	mhbc	nyny	433	----	range management	stoddart,la; smit	1955
aubo	jwis	nyny	558	----	time, life and man	striton,ra	1959
aubo	stac	hapa	377	----	crusade for wildlife	trefethen,jb	1961
aubo	mhbc	nyny	466	----	biol control systems analy	milsum,jh	1966
edbo	acpr	nyny	276	----	systems analysis in ecolog	watt,kef	1966
aubo	mhbc	nyny	450	----	ecol, resour man: quant ap	watt,kef	1968
aubo	dnhp	nyny	197	----	design with nature	mcharg,il	1969
aubo	wiin	nyny	286	----	intro mathematical ecology	pielou,ec	1969
edbo	acpr	nyny	383	----	ecosystem concept, n r man	van dyne,gm	1969
edbo	acpr	nyny	259	----	ecosys concept, fish, game	van dyne,gm	1969
edbo	acpr	nyny	610	----	systems anal, simula, ecol	patten,bc	1971
aubo	wiso	wadc	320	----	nat res & pub rela, 2nd ed	gilbert,dl	1975
aubo	winp	nyny	409	----	an amer cruside for wildlf	trefethen,jb	1975
aubo	fost	nyny	426	cerv	antelope, deer, north amer	caton,jd	1877
aubo	macm	nyny	232	od--	hunting north american dee	carhart,ah	1946
edbo	stac	hapa	668	od--	deer of north america	taylor,wp	1956
aubo	stac	hapa	128	od--	if deer are to survive	dasmann,w	1971
aubo	vipr	nyny	194	od--	deer of the world	whitehead,gk	1972
edbo	nhfg	conh	256	odvi	the white-t deer, n hampsh	siegler,hr	1968
aubo	ucap	beca	567	odhe	a herd of mule deer	linsdale,jm; tomi	1953
edbo	unbp	line	605	odhe	mule, black-t deer, n amer	wallmo,oc	1981
aubo	oxup	loen	215	ceel	herd, red dee, stud, behav	darling,ff	1937
aubo	cite	oxen	74	ceel	ecology of red deer	mitchell,b; stai/	1977
edbo	wimi	wadc	....	ceel	ecology and management	thomas,jw; towei	in pr
aubo	uwyp	lawy	294	ceel	n amer elk: ecol,behav,mgt	boyce,ms; hayden-	1979
aubo	utop	toon	280	alal	north american moose	peterson,rl	1955

TYPE	PUBL	CITY	PGES	ANIM	KEY WORDS-----------------	AUTHORS/EDITORS--	YEAR
aubo	stac	hapa	238	anam	prnghrn antlp & its mngmnt	einarsen,as	1948
aubo	utop	toon	991	bibi	n amer buffalo, wild state	roe,fg	1970
aubo	aakn	nyny	339	bibi	the time of the buffalo	mchugh,t	1972
aubo	uopr	nook	247	ov--	the great ark of the wild	clark,jl	1964
aubo	qupr	oton	166	obmo	muskoxen,biol,taxon,canada	tener,js	1965
aubo	mhbc	nyny	479	wldl	v.I, wildlife management	trippensee,re	1948

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
MDCBA	5----	1	64	odvi	w-tailed deer of minnesota	erickson,ab; gunv	1961
MDCRA	14---	1	80	odvi	michigan white-tailed deer	jenkins,dh; bartl	1959
RWLBA	6---2	153	325	odvi	w-t deer of the adirondcks	townsend,mt; smit	933
RWLBA	6---2	327	385	odvi	wntr, spr obsrv, adirndcks	spiker,cj	1933
WCDBA	14---	1	282	odvi	white-tailed deer, wiscons	dahlberg,bl; guet	1956

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
AZWBA	3----	1	109	odhe	in arizona chaparral	swank,wg	1958
CAFGA	26--2	139	166	odhe	calif deer, rcky mt mule d	mclean,dd	1940
CFGGA	8----	1	163	odhe	life hist, managemt, calif	taber,rd; dasmann	1958
CGFPA	4----	1	39	odhe	lit review, mvmnts & captr	siglin,rj	1965

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
UCPZA	88---	1	209	ceel	tule elk: hist, behav, eco	mccullough,dr	1969
WLMOA	16---	1	49	ceel	status, ecol, roosevel elk	harper,ja; harn/	1967
WLMOA	24---	1	66	ceel	the sun river elk herd	knight,rr	1970

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
AMNAA	52--2	392	399	alal	observ in yellowstone park	mcmillan,jf	1954
FUNAA	8....	40	43	alal	moose habits and habitat	rush,wm	1946
MUZPA	25---	1	44	alal	the moose of isle royale	murie,a	1934
NCANA	101--	1	436	alal	ecol, proc inter sym, pt 1	bedard,j	1974
NCANA	101--	437	735	alal	ecol, proc inter sym, pt 2	bedard,j	1974

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
BPURD	2----	1	215	rata	ecol, caribou, prudhoe bay	white,rg; thomso/	1975
CWRSB	38---	1	71	rata	biology, kaminuriak popula	dauphine,tc,jr	1976
UABPA	8----	1	82	rata	ecology, managment, sweden	skunke,f	1969
WMBAA	10A--	1	79	rata	prelim investigation, pt 1	banfield,awf	1954
WMBAA	10B--	1	112	rata	prelim investigation, pt 2	banfield,awf	1954
WMBAA	12---	1	148	rata	caribou, continued studies	kelsall,jp	1957
WMBAA	15---	1	145	rata	barrn gr carib, coop study	kelsall,jp	1960

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
AMNAA	43--2	257	354	anam	life hist,ecol,rng use,tex	buechner,hk	1947
CAFGA	30--4	221	241	anam	prong-hornd antlp in calif	mclean,dd	1944
JOMAA	3----	82	105	anam	the prong-horn	skinner,mp	1922

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NPSMD	161--	1	161	bibi	bison, yellowston nat park	meagher,mm	1973

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
AMNAA	24--3	505	580	ov--	distribut, variat, no amer	cowan,imct	1940
AZWBA	1----	1	153	ov--	desert bighorn	russo,jp	1956
WLMOA	4----	1	174	ov--	united sta, past to future	buechner,hk	1960

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
AMNAA	56--2	297	324	ovca	ecology of mountain sheep	mccann,lj	1956
IGWBA	1----	1	154	ovca	stat, life hist, mgt, idah	smith,dr	1954
JOMAA	18--2	205	212	ovca	prelim study, yllwstn n pk	mills,hb	1937
JOMAA	20--4	440	455	ovca	bighorn sheep of texas	davis,wb; taylor,	1939
JOMAA	24--1	1	11	ovca	notes on life histor, colo	spencer,cc	1943

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
SCBUB	35--6	29	76	ovca	survey, sierra nevada bigh	jones,fl	1950
WGFBA	1----	1	127	ovca	wyoming bighorn study	honess,rf; frost,	1942
WLMOA	4----	1	174	ovca	bighorn sheep in the u s	buechner,hk	1960
XNFSA	6----	1	242	ovca	bighorn of death valley	welles,re; welles	1961

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
WMBAA	9----	1	34	obmo	prelim stud,ellesmr is,nwt	tener,js	1954

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CAFNA	81--1	1	22	oram	obsrvtns,kootenay nt pk,bc	holroyd,jc	1967
CGFPA	8----	1	23	oram	literature review, ecology	hibbs,ld	1966
IGWBA	2----	1	142	oram	life history, mgtmt, idaho	brandborg,sm	1955

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JTBIA	2---1	63	68	----	environments of anim, plan	browning,to	1962

OTHER PUBLICATIONS

Proceedings of the White-tailed Deer in the Southern Forest Habitat Symposium (First meeting in 1962)

Transactions of the Annual Meeting of the Northeast Deer Study Group (Annual meeting beginning 1964)

Proceedings of the North American Moose Conference (Fifth conference in 1968)

Proceedings of the International Reindeer/Caribou Symposium (First meeting in 1977, second in 1980)

Proceedings of the Biennial Antelope States Workshop

Transactions of the Interstate Antelope Conference

Transactions of the North American Wild Sheep Conference (Second meeting in 1976)

Transactions of the Desert Bighorn Council (Annual meeting beginning 1957)

Proceedings of the International Mountain Goat Symposium

Proceedings of the Annual Conference of Western Association of State Game & Fish Commissioners (Annual conference beginning 1921)

TOPIC 1. POLITICALLY-DEFINED LAND AREAS

Management of wild ruminant habitats may be done to different extents on areas with different political histories and boundaries. In the United States, state governments have jurisdiction over wildlife resources, except for endangered species. Then, the federal government has jurisdiction.

States, provinces, and countries make up the land areas within which habitat management decisions are made. Laws govern these areas, regulating not only what can be done on land areas within political units but also the extent of land areas that may be set aside for habitat management.

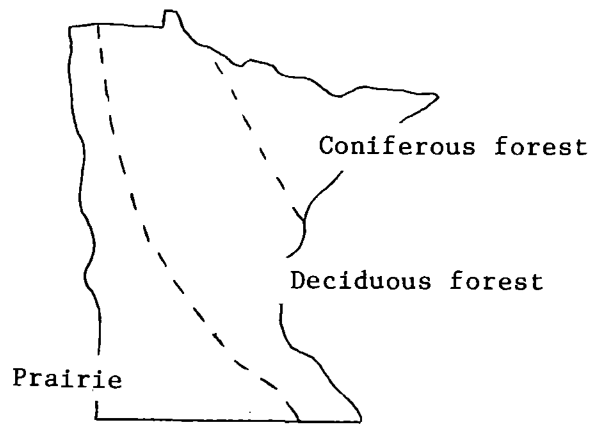
Wildlife refuges and management areas may be set aside within states, provinces, and countries for the primary purpose of enhancing wildlife populations. These may have species priorities, in which case habitat manipulation for a species or group may be extensive. Parks are often considered to be rich in wildlife, but scenic priorities may be higher than any species priorities, in which case little or no habitat management may be done. This sometimes results in depressed wildlife populations.

Some land areas may not be set aside as a management area, a refuge, or park, but still may be the basis for identifying a herd. Topographical features--the Edwards Plateau in Texas, for example--are often the basis for such land area designations.

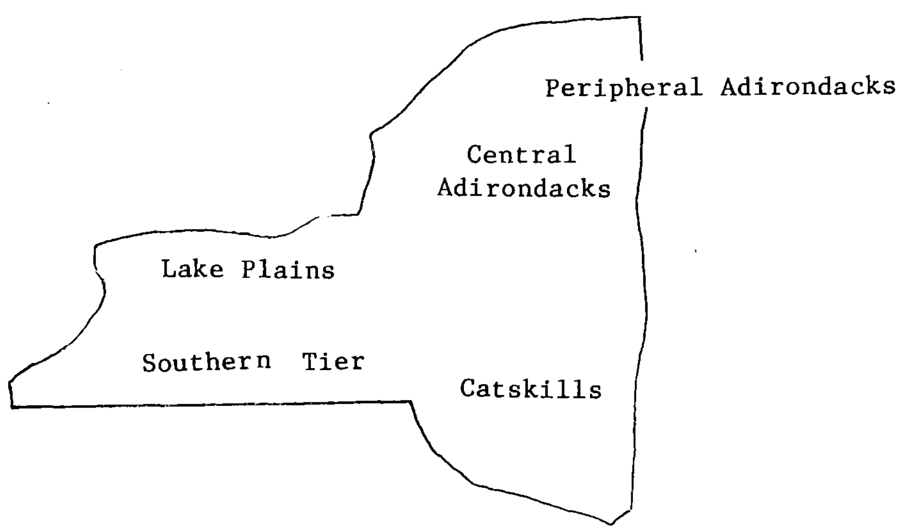
The two UNITS which follow include brief discussions of habitat manipulations in states and provinces (UNIT 1.1) and countries (UNIT 1.2). This breakdown is made to accomodate the literature; articles often describe wildlife management in particular states, provinces, or countries, and those papers end up in these two UNITS. References describing habitat manipulations and management may also be found in other TOPICS and UNITS.

UNIT 1.1: STATES AND PROVINCES

Habitats and habitat management practices are different in the different states and provinces in North America. Similarities exist within regions, such as the Lake States (Minnesota, Wisconsin, Michigan), the Northeast (New York, Massachusetts, Vermont, New Hampshire, Maine, and others), the Southeast (Florida, Georgia . . .), Pacific Northwest (Washington, Oregon . . .), prairie provinces (Alberta, Saskatchewa, Manitoba . . .), etc. There are differences within many of these states and provinces, however. Minnesota, for example, includes three major habitat types--prairie, deciduous forest, and coniferous forest--as illustrated below.



New York State has five major regions--Central Adirondacks, Peripheral Adirondacks, Catskills, Southern Tier, and Lake Plains.



Differences in these habitat types and land formations result in different priorities for resource allocation. The fertile prairies of western Minnesota are used primarily for agricultural purposes, and deer production is not as high as it could be if wildlife, rather than agriculture, were the top priority.

Agricultural states, such as Ohio, are often short of winter cover, but little can be done to promote large-scale plantings because agriculture is a higher priority. In areas where agriculture is less productive, forest acreages are increasing. In time, abandoned old fields will be forested, with the loss of important highly productive sources of herbaceous forage (Nixon et al. 1970). They recommend that a minimum of 10% of each 1500-acre forested unit on public hunting areas where deer management is important be maintained as old fields, and suggest that controlled burns would be an effective management tool.

It is interesting to note the concern over successional trends in Ohio. Deer are often thought of as forest animals, but too much forest is not the best habitat for white-tailed deer. They are much more adaptable than some other species of wild ruminants. The habitat requirements of pronghorn are much more specific than those of white-tailed deer. States having large areas of open habitats are the only candidates for pronghorn populations.

LITERATURE CITED

Nixon, C. M., M. W. McClain, and K. R. Russell. 1970. Deer food habits and range characteristics in Ohio. J. Wildl. Manage. 34(4):870-886.

REFERENCES, UNIT 1.1

STATES AND PROVINCES

BOOKS

TYPE	PUBL	CITY	PGES	ANIM	KEY WORDS-----------------	AUTHORS/EDITORS--	YEAR
edbo	acpr	nyny	541	odvi	manag of wetlands, hab imp	wiley,m	1976
aubo	nmgf	sfnm	212	wldl	new mexico, cons and manag	ligon,js	1927
aubo	naus	nyny	96	wldl	wildlf habitat improvement	shomon,jj; ashba/	1969
aubo	ropr	nyny	129	wldl	wldlf,alaska/an ecol recon	starker,as; darli	1953
edbo	mfgd	hemt	238	game	game management in montana	mussehl,tw; howel	1971

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
BNMFD	5----	1	41	od--	deer of new mexico	lang,em	1957

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
ALCNA	15--8	8	....	odvi	white-tails in alabama	moore,gc	1944
ALCNA	31--3	8	9	odvi	alabam has deer & problems	lueth,fx	1959
CNBUA	348--	1	16	odvi	deer herd, land owner,conn	mcdowell,rd; bens	1960
ICNSA	12--1	97,	102	odvi	iowa deer problem & solutn	harlan,jr	1953
JFUSA	71-12	752	757	odvi	manag hab, loblol-short le	halls,mk	1973
JWMAA	32--2	321	329	odvi	brush vs clear rang, texas	davis,rb; winkler	1968
JWMAA	5---2	182	190	odvi	study, edwards plateau, tx	sanders,e	1941
JWMAA	11--3	263	266	odvi	huron mount deer hrd, mich	manville,rh	1947
JWMAA	12--4	428	432	odvi	management of georgia deer	allen,gw	1948
JWMAA	34--4	870	886	odvi	food hab, rang char in ohi	nixon,cm; mcclai/	1970
MOCOA	13-10	1,3	12	odvi	some prosp on deer, missou	robb,d	1952
MRYCA	19--3	6	8	odvi	worcester county deer herd	wilson,ka; vaughn	1942
MRYCA	36--2	23	25	odvi	maryland new deer citizens	flyger,vf	1959
MRYCA	43--2	1A	8A	odvi	maryland deer report, 1965	rubelman,r	1966

odvi continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NAWTA	4----	257	267	odvi	management in s east ohio	chapman,fb	1939
NAWTA	22---	412	424	odvi	wld turkey, manage habitat	davison,ve; graet	1957
NAWTA	22---	501	519	odvi	exprmntl deer yrd mgt, n h	laramie,ha,jr; do	1957
NAWTA	42---	278	285	odvi	mainten urbn herd winnepeg	shoesmith,mw; koo	1977
NFGJA	3---2	129	167	odvi	history of wtd in new york	severinghaus,cw;/	1956
NYCOA	2---3	6	7	odvi	the whitetail in new york	skiff,jv	1947
NYCOA	8---1	22	23	odvi	mgt problem in southern ny	cheatum,el	1953
PCGFA	12---	213	224	odvi	the tensas deer herd	brunett,le	1959
PIAIA	72---	207	217	odvi	status & managemnt in iowa	kline,pd	1965
PMACA	14---	....	....	odvi	deer yards, uppr pen, mich	wakeman,mc	1933
RRFBA	19---	66	75	odvi	status of wtd in tennessee	schultz,v	1955
RWLBA	6---2	161	325	odvi	w-t deer of the adirondcks	townsend,mt; smit	1933
TNWSD	10---	1	20	odvi	from bucks to deer, w virg	degarmo,wr	1952
TNWSD	10---	1	17	odvi	aspects of herd in new jer	sweet,jc; wright,	1952
WSCBA	14--4	3	6	odvi	deer management in minneso	blair,fd	1949
WSCBA	33--5	10	11	odvi	made to order deer range	botwinske,ca	1968
XFNCA	39---	19	22	odvi	midwestern deer habitat	crawford,hs,jr	1970

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CAFGA	26--2	139	166	odhe	deer of calif, ref mule de	mclean,dd	1940
CAFGA	36--1	27	52	odhe	prog rpt, interstat, calif	interstate deer herd committee	1950
CAFGA	40--3	235	266	odhe	prog rpt,devils garden,cal	interstate deer h	1954
JWMAA	24--3	265	271	odhe	cassia herd of sthrn idaho	mcconnell,br; dal	1960
NAWTA	3----	368	375	odhe	mngmnt, kaibab plat, arizo	boone,rp	1938
NAWTA	20---	568	588	odhe	brushlands, arizona, influ	hanson,wr; mccull	1955
PORSA	9....	1	15	odhe	envir probl of cent oregon	eshelman,w; nolf,	1973
SALKA	4----	182	186	odhe	distributn, biga in alaska	olson,st	1953
XFRMA	91---	1	28	odhe	odvi, class habit pond pin	thilenius,jf	1972

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
BNMFD	8----	1	33	ceel	elk of new mexico	lang,em	1958
JWMAA	24--1	15	21	ceel	roosevelt elk, afognak isl	troyer,wa	1960

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NAWTA	18---	539	552	alal	progr, mgt, s centr alaska	spencer,dl; chate	1953
NAWTA	18---	553	560	alal	rata, eff land use, alaska	leopold,as; darli	1953
NCANA	101-3	657	671	alal	some aspects of man, newfo	mercer,we; manuel	1974
NCANA	101-3	673	687	alal	manage in ontario, 1948-73	cumming,hg	1974
NCANA	101-3	705	721	alal	moose management in alaska	rausch,ra; somer/	1974
ORYXA	2---5	280	285	alal	rata, caribou, reind, alas	darling,ff	1954
WSCBA	33--2	18	20	alal	bulls and hat racks, wisco	hartman,gf	1968

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JOMAA	32--3	329	337	rata	status, wodlnd cari, ontar	de vos,a; peterso	1951
JWMAA	11--3	283	284	rata	woodland caribo, minnesota	nelson,uc	1947
JWMAA	31--4	621	642	rata	manageme of labrador carib	bergerud,at	1967
OFWRA	4---4	3	8	rata	woodlnd caribou in ontario	simkin,dw	1965

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NAWTA	8----	117	122	anam	wyom, hist and wartime mgt	allred,wj	1943

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
IGWBA	1----	1	154	ovca	statu, lif hist, mgt, idah	smith,dr	1954
JOMAA	20--4	440	455	ovca	the bighorn sheep of texas	davis,wb; taylor,	1939
JOMAA	25--4	364	367	ovca	hist, statu in s c new mex	halloran,af	1944
NAWTA	4----	253	256	ovca	ecol, mngmnt, mt rang, nev	allen,jc	1939

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NAWTA	15---	612	625	ovda	rata, status in alaska	scott,rf; chatel/	1950

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	34--1	1	15	obmo	muskox, nunivak isl, alask	spencer,dl; lensi	1970

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
IGWBA	2----	1	142	oram	life history, mgtmt, idaho	brandborg,sm	1955
NAWTA	34---	409	418	oram	the mountn goat in colorad	hibbs,d; glover,/	1969

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
FNQBA	16...	1	48	many	integrated man, fauna, for	potvin,f	1975
TRVIA	108--	181	202	many	mngmnt, land use, u states	petrides,ga	1961

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
ANKIA	55--6	170	174	wldl	what's happening in alaska	darling,ff; leopo	1952
FRCRA	27--4	330	334	wldl	forest wldl prob, n brnswk	wright,bs	1951
JFUSA	38--1	27	30	wldl	mgmt south jersey pine bar	moore,eb	1940
JFUSA	41-11	792	797	biga	multiple land use in utah	olsen,o	1943
JFUSA	48-10	700	702	wldl	cooperative mana, virginia	mosby,hs	1950
JFUSA	52--2	137	138	wldl	wildlife in alaska[review]	presnall,cc	1954
JWMAA	5---4	357	370	biga	early histori rec, montana	koch,e	1941
JWMAA	13--4	392	411	biga	biga management, colorado	hunter,gn; yeager	1949
NAWTA	1----	365	368	----	penn's field game investig	gerstell,r	1936
NAWTA	24---	472	479	biga	mangmnt in the lake states	ruhl,hd	1959
NMWIA	13...	10	11	----	we did the impossible!	barker,es	1968
XAMPA	1147	1	220	wldl	range, wildl hab evaluatio	paulsen,ha,jr; r/	1970

CHAPTER 21, Worksheet 1.1a

Major vegetation types or ecological zones
in the different states and provinces

Native vegetation types present are dependent on soil and weather factors. Sketch your state or province in the space below and draw in the native vegetation types. Use this as base-line information when considering habitat management practices.

UNIT 1.2: COUNTRIES

This UNIT on habitat management in different countries is included here in order to provide a place for papers describing the management of wild ruminants in areas other than North America. The centuries-old and intensive management practices in Europe will provide insights into future management in at least some areas of North America.

Also, general papers describing management in the United States and Canada are included here rather than in the previous unit on states and provinces.

REFERENCES, UNIT 1.2

COUNTRIES

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
JFUSA	34--5	460	466	cerv	deer and dauerwald,germany	leopold,a	1936
JWMAA	21--2	221	225	cerv	account, deer in australia	bentley,a	1957

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
XDAFA	330..	1	20	od	deer farming in the u s	USDA	1908

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
NAWTA	14---	543	553	odvi	white-ta deer, u s, canada	bartlett,ih	1949
SRBSB	8---1	403	412	odvi	effective effort, nat prot	kirk,g	1976

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JOMAA	51--3	611	614	ceel	c elaphus in southrn tibet	caughley,g	1970
NZJFA	8---2	293	324	ceel	establish rang, tararua mt	davidson,mm; kean	1960
NZTBA	36...	429	463	ceel	conditn, ecol, mngmnt, n z	riney,ta	1955
SFORA	21--1	15	18	ceel	mangmmt, control, scotland	macnally,l	1967
TRVIA	108-1	9	40	ceel	hist, status, consrv, scot	lowe,vpw	1961
VILTA	3---1	3	88	ceel	histry of distr, scandinav	ahlen,i	1965
VMUBA	28--3	23	28	ceel	settlin of maral in russia	fadeev,ev	1973
XFIPA	24---	1	15	ceel	od, prob,hab mgt,n forests	lyon,lj	1966

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
BYMOA	80--6	42	48	alal	elk, altai mountains, ussr	sobanskii,gg	1975
NCANA	101-1	185	194	alal	moose in fennoscandinavia	markgren,g	1974
NCANA	101-3	643	656	alal	manag in conif decid ecoto	karns,pd; haswel/	1974
NCANA	101-3	723	735	alal	manag in norway and sweden	lykke,j	1974
WLSBA	4---4	167	174	alal	odvi, hist manage, finland	salo,lj	1976

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
OCRNA	16--1	71	73	rata	alal, odvi, cons of nature	pop,i	1972
WMBAA	10---	1	275	rata	prelim invest, barren-gr c	banfield,awf	1954
WMBAA	12---	1	148	rata	continued barrn-gr studies	kelsall,jp	1957

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
BICOB	3---4	255	263	obmo	managem controvers, n amer	lent,pc	1971

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
BZOBA	24--3	227	232	many	nat prot, wild prot, hunti	hus,s	1973
EVCNA	3---1	33	42	many	envir and nat cons in iran	firouz,e	1976
JWMAA	34--4	800	812	many	game managem in yugoslavia	isakovic,i	1970
TRVIA	108--	181	202	many	mngmnt, land use, u states	petrides,ga	1961

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
TCNSA	89...	5	8	caca	the roe deer in wales	matheson,c	1962
TRVIA	108-1	41	53	caca	biology, managmnt, denmark	andersen,j	1961

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
ORYXA	7---6	291	294	dada	the persian fallow deer	pepper,hj	1964

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
ANKIA	54--3	77	79	bibo	still a chance, eur wisent	bridges,w	1951
ATRLA	12-28	391	405	bibo	free-living european bison	krasinski,z	1967

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
PZESA	15...	68	....	dogo	res, feral goats, n zealnd	rudge,mr	1968

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
IUCSB	17...	116	120	wldl	protec, ussr, in-out of us	bannikov,ag	1970
JFUSA	69-10	736	740	game	prod and harvest, czechosl	reynolds,hg	1971

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NAWTA	24---	472	479	biga	mngmnt in the lake states	ruhl,hd	1959
NZSRA	16--3	33	36	mamm	land use, problm, n zealnd	riney,t	1958
TRVIA	108-1	130	157	ungl	ecol, mngmnt, intr, n zeal	wodzicki,k	1961

TOPIC 2. HABITAT MANAGEMENT AREAS

Habitat management areas discussed in this TOPIC include wildlife management areas (UNIT 2.1), wildlife refuges and preserves (UNIT 2.2), wilderness areas (UNIT 2.3), parks, national monuments, and recreation areas (UNIT 2.4), and state and national forests (UNIT 2.5). These areas are identified by their legal status rather than by political boundaries as states and provinces are, and their legal status is usually attained as a result of their geological and ecological characteristics. Once a certain type of legal status has been attained, laws governing such areas apply. Thus the Boundary Waters Canoe Area in northeastern Minnesota may not be the sight of active habitat management practices as vehicular traffic, airplanes, chemicals, fire, etc are not allowed or strictly regulated. Yellowstone National Park, like other national parks, is not open to hunting. National forests, on the other hand, are logged by private contractors, so habitat management effects occur, by design or default.

Habitat management areas are sometimes set up for the benefit of particular species or groups of species. Such areas may be particularly effective for some groups, such as waterfowl, because their needs are rather distinct and they use rather small local areas with high intensity. Wild ruminants are large animals that often range widely, making it more difficult to set aside areas of particular value to a group of animals.

Wildlife management areas, refuges and preserves, wilderness areas, parks, and state and national forests are all of potential benefit to wild ruminants. Wildlife management areas, state and national forests are usually available for habitat management practices, and they are usually open to hunting. Refuges, preserves, wilderness areas, parks, and recreation areas are often not available for habitat management practices, and they are usually not open to hunting. Thus there is a range of habitat management practices possible on areas set aside for different purposes. The UNITS which follow include discussions of these different possibilities.

UNIT 2.1: WILDLIFE MANAGEMENT AREAS

Wildlife management areas are publicly or privately owned areas set aside for the primary purpose of managing the habitat for the production of wildlife. Most states have a program for the acquisition and management of such areas. Areas selected for purchase or lease as management areas are often important habitats that are vulnerable to destruction as wildlife habitat, "development" as human habitat. Critical wintering areas, calving grounds and south-slope concentration areas are examples of areas that appear to be particularly important to populations, and have high priorities for designation as wildlife management areas.

Management of the summer ranges of wild ruminants has not been given much attention. It is green and growing, though not necessarily of the nutrient quality necessary for high production by the consumers. Weather conditions, such as dry spells, affect primary production, but do not usually cause mass mortality as adverse winter range conditions might. Thus summer range is usually not managed. Differences in productivity have been observed, however; a mule deer herd on poor summer range in Utah had fall weights ranging from 65 to 82% of the fall weights of those on a good summer range in Idaho, and ovulation rates of does in the poor range were only 67% of those on the good range (Julander *et al*. 1961). Until good estimates of animal requirements are made, quality of summer range, or any range at any time of the year, remains to be estimated subjectively.

Response of mule deer to mangement of summer range in the Kaibab National Forest, Arizona were demonstrated by Hungerford (1970). Reseeding practices resulted in improved summer deer conditions and a 25% better farm crop. Yearlings were more responsive to management effects than adults, which is biologically reasonable because one-year old animals simply do not have the body mass and reserves to sustain themselves during the first winter that adults have. Thus yearlings were in poorer condition in June in the Kaibab National Forest than adults were, with rib and hip bones showing after mid-June. The yearlings that fed in seeded meadows and logged and burned areas appeared to be in good condition before mid-June. Summer coat condition also developed more rapidly on the later deer (Hungerford 1970).

There are few studies that show benefits of management practices on wild ruminants, while there are many studies that show the effect of overpopulation on both animal and range. The benefits of wildlife management areas should be evaluated and expressed in terms other than numbers alone. If habitat improvement practices result in increases in numbers *and* enhanced body condition, there is additional justification for investing time and money in such areas and in management practices.

LITERATURE CITED

Hungerford, C. R. 1970. Response of Kaibab mule deer to management of summer range. J. Wildl. Manage. 34(4):852-869.

Julander, O., W. L. Robinette, and D. A. Jones. 1961. Relation of summer range condition to mule deer herd productivity. J. Wildl. Manage. 25(1):54-60.

REFERENCES, UNIT 2.1

WILDLIFE MANAGEMENT AREAS

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
PCGFA	29---	481	492	odvi	energy bal criterion acqui	rayburn,eb; giles	1975

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	25--1	54	60	odhe	sum range condi, herd prod	julander,o; robi/	1961
JWMAA	34--4	852	862	odhe	resp kaibab m-deer man sum	hungerford,cr	1970
NAWTA	3----	368	375	odhe	deer mngment on the kaibab	boone,rp	1938

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
				rata			

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

oram

UNIT 2.2: WILDLIFE REFUGES AND PRESERVES

Wildlife refuges, "places to flee from the hunter," seem, at first glance, to be good for wildlife. Burroughs (1946) states "...it was generally believed that closing an area to all hunting would work wonders in increasing game populatins, particularly if predator species were kept in check. This belief is still widespread among sportsmen, and it is difficult to convince them that factors other than over-hunting and predation may be more important in limiting animal populations."

The statement above was made 30 years after Michigan "entered the game refuge business," and 8 years after federal aid in wildlife restoration funds were made available. He summarizes the state's experiences with refuges and hunting, noting that a rise and decline of big game refuges in Michigan as a shift from "refuge" to "public hunting ground" followed the build-up of deer numbers and over-browsing of a winter range.

If a refuge or preserve functions as it is intended to, providing a place to live with a low risk of death before old age, then populations of wild ruminants quickly build up to levels that will drastically alter the plant communities on the refuge. Changes in numbers can be demonstrated quickly and easily with the exponential predictions described in CHAPTER 19, UNIT 4.2, and the forage requirements of different populations may be estimated by going through the weight→metabolism→forage required sequence of calculations for populations.

Life, ecologically, includes birth and death. A species is sucessful when the rates of these significant events result in population that are in balance with range resources. Birth is obviously necessary, and death is equally necessary whenever there is a limit to resources needed.

When, and under what conditions do refuges serve a useful purpose? Refuges serve a useful purpose when range resources are abundant and animal numbers are few due to factors other than the supply of range resources. Suppose over-hunting resulted in the extermination of a population in a particular area that was located in such a position that natural immigration would not likely occur. Trapping of wild stock in another area and transplanting them to the new area justifies refuge or sanctuary status until the population is established. After it is established and in balance with range resources, removal of the annual production becomes imperative unless range resources are enhanced, which is costly and ecologically undesirable. Every farmer knows that cattle herds are successfully maintained in good condition only by removal of the annual surplus, keeping the breeding and producing herd in balance with farm resources.

The necessity for removal of an annual surplus is illustrated by the bison herd in Custer State Park, western South Dakota. Once on the brink of extinction, bison herds are now alive and well in many areas. The Custer herd is maintained by selective removal of animals from the herd, thus maintaining the herd and its value to the viewing public, while protecting the rather delicate prairie on which the animals live. Since the animals cannot roam over the extensive areas used before settlement, both the area and the resources per unit area are limited, which necessittes removal of annual surplus.

This is such a fundamental concept, yet the public as a whole has difficulty grasping it, and often develops a sentiment against removal of the annual surplus (which is an amount equal to the annual production) when a population is in reasonable balance with range resources. The concept may be more readily understood if some basic facts are presented, such as the ecological cost of living, in relation to the resources available, such as forage energy.

It is my opinion that many of the difficulties arise from inadequate and incomplete preparation of the biological foundations. It is too easy to enter the arena of argument at the emotional level, restricting the argument to whether there are too many or too few animals. The public, wanting to provide a "refuge" for wild animals, will almost inevitably argue that there are too few.

LITERATURE CITED

Burroughs, R. D. 1946. Game refuges and public hunting grounds in Michigan. J. Wildld. Manage. 10(4):285-296.

REFERENCES, UNIT 2.2

WILDLIFE REFUGES AND PRESERVES

BOOKS

TYPE	PUBL	CITY	PGES	ANIM	KEY WORDS-----------------	AUTHORS/EDITORS--	YEAR
aubo	monp	bama	143	wldl	sketches of american wildl	young,sp	1946
aubo	macm	nyny	257	wldl	wildlife refuges	gabrielson,in	1943

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	2---3	151	161	odvi	trappn, pisgah nat pr, n c	ruff,fj	1938
JWMAA	7---2	203	216	odvi	doca, mngmnt, aransas, tex	halloran,af	1943
JWMAA	9---3	237	242	odvi	great plains regn, dakotas	cook,fw	1945
JWMAA	10--4	285	296	odvi	biga,refug, pbl hntng,mich	burroughs,rd	1946
JWMAA	18--4	482	495	odvi	mgmnt study,mud lake, minn	hunt, rw; mangus,	1954
JWMAA	19--3	346	352	odvi	control hunts, tamarac nat	krefting,lw; eri/	1955
JWMAA	20--3	297	302	odvi	result spec hunt, mud lake	krefting,lw; eric	1956
JWMAA	33--4	791	795	odvi	contr hnt,crab orch nat rf	rodaberry,jl; au/	1969
NAWTA	3----	248	255	odvi	mngmnt, pisgah nat game pr	schilling,ea	1938
NYCOA	6---4	28	29	odvi	adirondack deer problem	ny conservat dept	1952
PCGFA	27---	143	152	odvi	10 yrs mgt, whiter nat ref	wilson,sn; mcmast	1973
PCGFA	29---	466	475	odvi	dynamic aspects, populatns	kammermeyer,ke; m	1975
TISAA	63--2	202	206	odvi	mort factrs, crab orch,ill	hawkins,re; klim/	1970

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CAFGA	29--4	180	190	odhe	refuges and the buck law	cronemiller,fp	1943
CAFGA	36--4	343	365	odhe	in chaparral forests,calif	cronemiller,fp; b	1950

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
POASA	43---	229	232	ceel	history, wichita mt refuge	halloran,af	1963

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

alal

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

rata

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

NAWTA 1---- 652 655 anam the pronghorn in southwest taylor,wp 1936

XAMPA 355-- 1 26 anam hart mt antelop refuge, or jewett,sg 1939

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

TRVIA 108-2 286 304 bibi ecol and mangmnt, amer bis fuller,wa 1961

XFWLA 95--- 1 20 bibi biga, preserves and ranges ruth,c 1937

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
ATRLA	12-19	323	331	bibo	history, bialowieza forest	krysiak,k	1967

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	24--2	191	196	doca	longhorn cattl man, wichit	halloran,af; shra	1960

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NAWTA	8----	339	346	biga	problems, big game refuges	park,bc	1943
NAWTA	34---	103	115	----	systms approach, refug mgt	giles,rh,jr; scot	1969
XFWLA	341--	1	6	biga	surplus anim,natnl refuges	u s fish, wildlif	1952
XFWLA	390--	1	6	biga	avail surpl, anim, nat ref	u s fish, wildlif	1957

Exponential population predictions with zero to low mortality

WORKSHEETS 4.2a in CHAPTER 19, UNIT 4.2, page 56a provided an opportunity to make exponential population predictions in a matter of seconds with a scientific calculator. Using the procedures described in that WORKSHEET and the format below from the second page (56aa) of that WORKSHEET demonstrate the growth of wild ruminant populations with zero or low mortality for 10 years, which is a minimum natural life span.

NAIP = ________

MTRT = ________

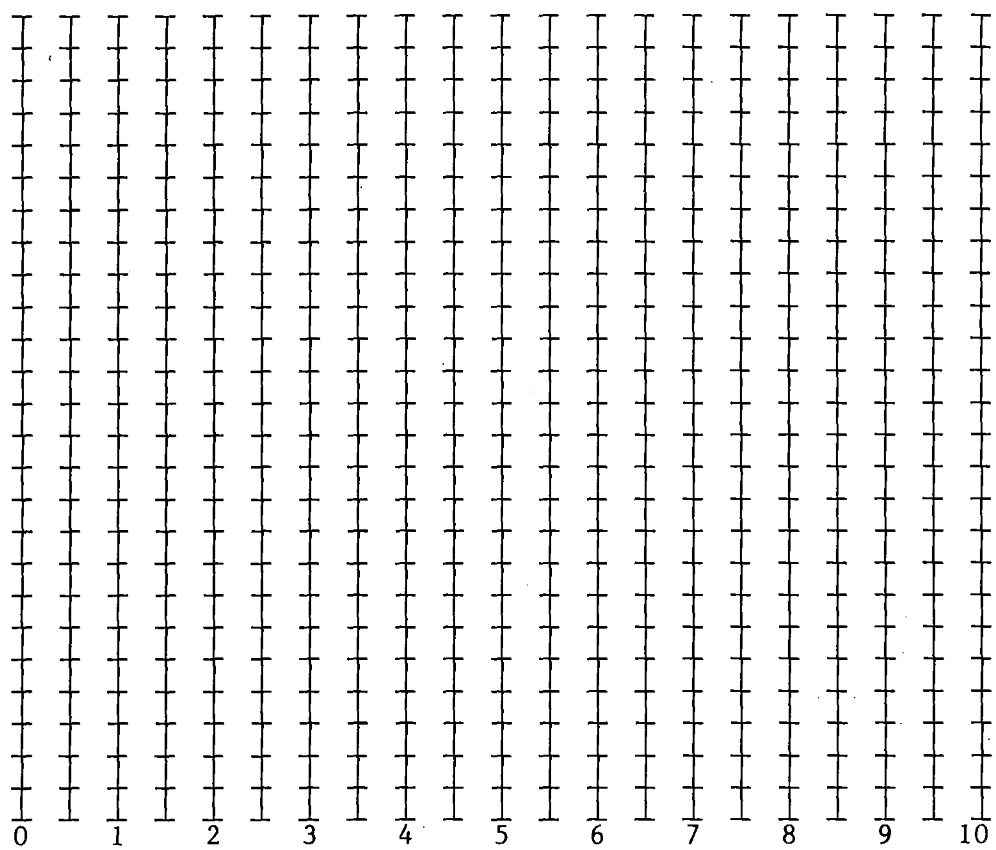
bMTR = ________

RPRT = ________ PRDN = = ________

bRPR = ________

bPOP = ________

YAPN = ________



NAIP = ________

MTRT = ________

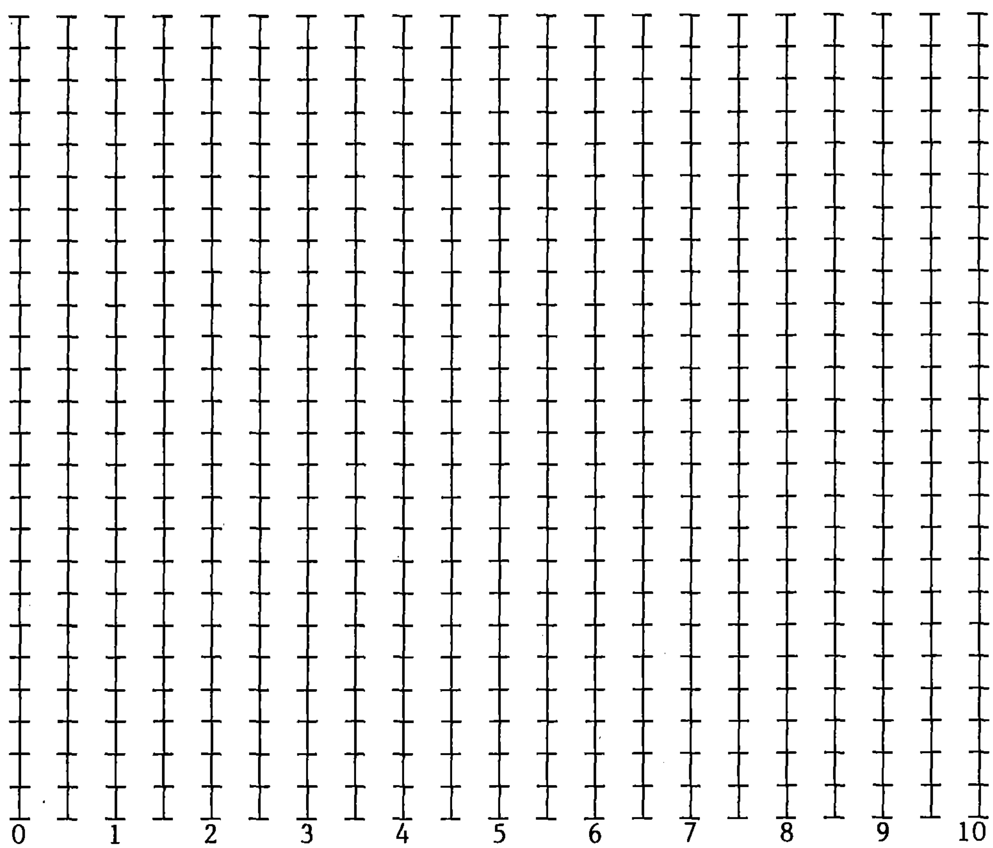
bMTR = ________

RPRT = ________ PRDN = = ________

bRPR = ________

bPOP = ________

YAPN = ________

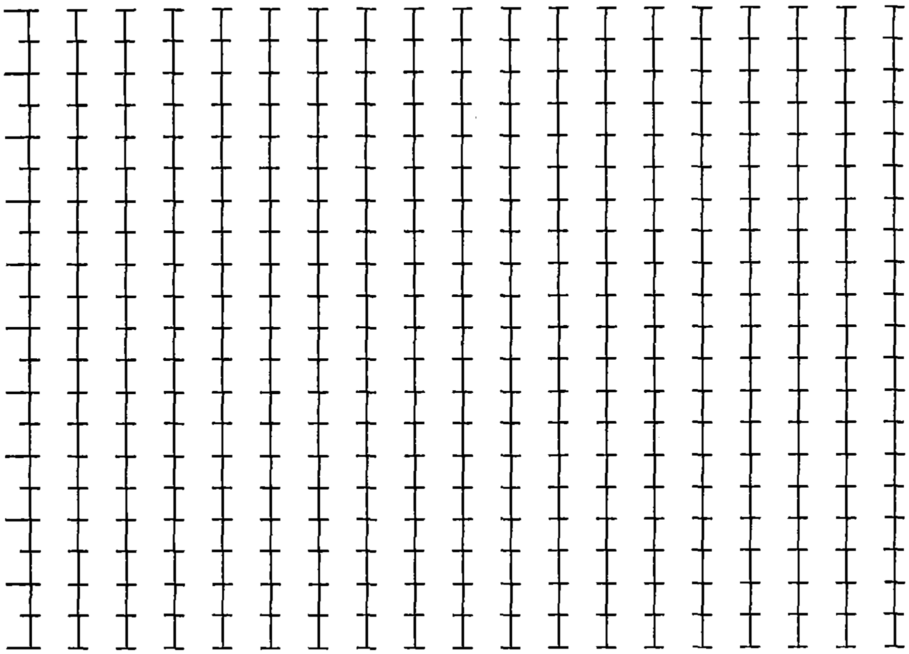


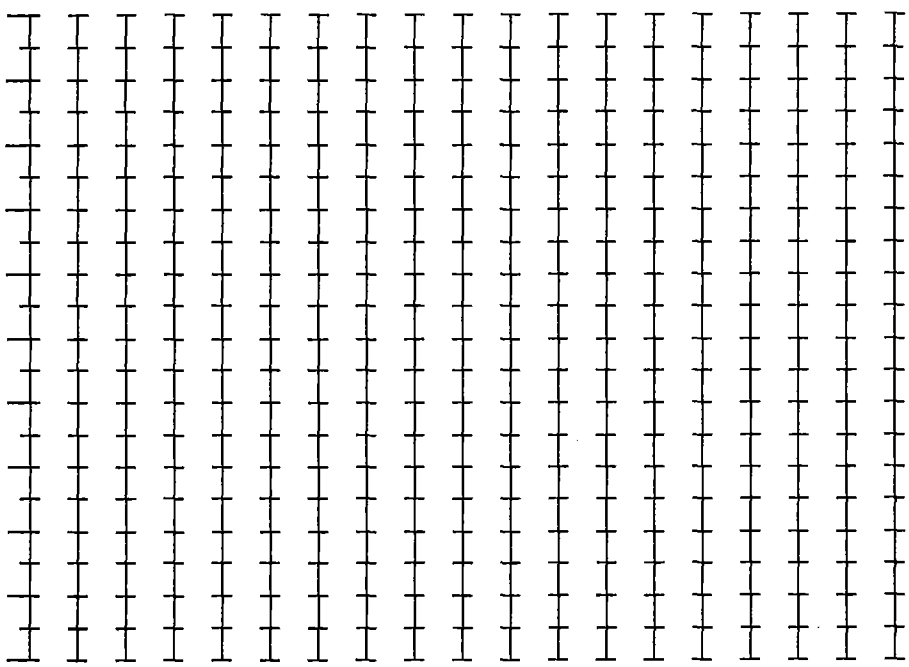
CHAPTER 21, WORKSHEET 2.2b

Forage requirement calculations for increasing populations

Calculations of forage required were discussed in PART IV, CHAPTER 12, TOPIC 3. Metabolic population structures were discussed in PART VI, CHAPTER 18, TOPIC 2. Population predictions were discussed in PART VI, CHAPTER 19, TOPIC 4. Review the UNITS and WORKSHEETS in these three TOPICS, choose the WORKSHEETS that are most appropriate for your data format, and calculate forage requirements for increasing populations.

Summarize your calculations in the space below, and use the grids on the next page to plot the increase in numbers and forage required.





UNIT 2.3: WILDERNESS AREAS

Wilderness predates settlement, but designation of "wilderness areas" is a modern phenomenon. Faced with the possibility of losing the last original and unsettled natural areas to the unrelenting encroachment by man, environmentalists and politicians have taken steps to preserve these remnants. It is a controversial issue, and will remain so as long as there is a desire for continued economic growth.

The idea of wilderness areas in national forests was proposed by Aldo Leopold in 1921. Leopold recommended that tracts of a minimum of 500,000 areas each be set aside in each western state. Such areas would be large enough for a two-week hunting or fishing trip on horseback, and would not be subject to road-building and artificial developments.

What is a wilderness area? There are legal guidelines to follow, but they are subject to change by political action. Ecologically, a wilderness area has characteristics similar to presettlement times, is large enough to remain "wilderness" by virtue of its own perimeter buffer zone, and contains fauna representative of presettlement times. Thus a wilderness area should contain not only the wild ruminants characteristic of its ecological history, but also their predators.

True wilderness areas are difficult to find, of course, especially in the lower 48 states. One example is the Boundary Waters Canoe Area in northeastern Minnesota (2 million acres) and ajacent Quetico Park in Canada. This large wilderness area contains deer, moose, and woodland caribou, and their predators, primarily wolves.

Gilligan (1954) questions whether national forest wilderness reservations are feasible, noting that primitive or virgin conditions are not to be found in designated wilderness areas, and that dams, logging operations, and other activities impinge on wilderness areas directly or inderictly. Further, the by-products of man's activities, such as acid rain from industrial operation, also impinge on wilderness areas. Some of these indirect effects are very insidious.

It is impossible to find completely pristine conditions anywhere in North America, but we must begin with what we have, enacting laws and management practices that will designate and allow certain areas of land to be as much like pre-settlement wilderness as possible.

Wilderness areas with a high level of ecological integrity must be left not only to nature's natural provisions but also its ravages. Thus, fires of natural origin should be left to burn. One might also argue that limited acreages of wilderness areas that would take hundreds of years to recover should be protected from such a perturbation as fire, simply because advanced stages in succession are too limited to lose. Such a wilderness area then becomes a protected and managed area, not allowed to be set back in succession by even a major natural perturbation because of its relict status.

Wilderness areas, by definition, cannot be subjected to anything more that minimal human impact. This is hard for persons interested in promoting equal rights and accessibility for all to accept, yet the concept must be defended. Certain habitats--wilderness, rugged mountainous topography, the moon . . . --simply do not fall within the realm of day-to-day activities. Personally, I am as content knowing the city is "there" without having to visit it as I would hope city dwellers would be concerning wilderness.

LITERATURE CITED

Gilligan, J. P. 1954. Wildlife values in western wilderness area management. J. Wildl. Manage. 18(4):425-432.

Leopold, A. 1921. The wilderness and its place in forest recreationaly policy. J. Forestry 19(7):718-721.

REFERENCES, UNIT 2.3

WILDERNESS AREAS

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
JFUSA	68-11	692	694	odvi	habitat mngmnt, eastrn for	jordan,js	1970
NYCOA	7---5	5	5	odvi	mngmnt, wldrness, adironda	cheatum,el	1953

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
JWMAA	18--4	521	526	rata	fire, declin, grey wells p	edwards,ry	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
				oram			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
EXJOA	.....	127	133	----	refuge in a wilderness	simmons,nm	1967
JFUSA	19--7	718	721	----	wilderness, nat for policy	leopold,a	1921
JWMAA	18--4	425	432	wldl	wildlif values,west wilder	gilligan,jp	1954

CHAPTER 21, Worksheet 2.3a

Wilderness area sizes in relation to animal movements

Sizes of national forest wilderness areas in western states are given by Gilligan (1954. Some examples are (640 acres = 1 square mile):

5,000 acres	=	7.8	sq. miles
47,000 acres	=	73.4	sq. miles
100,000 acres	=	156.3	sq. miles
300,000 acres	=	468.8	sq. miles
1,000,000 acres	=	1562.5	sq. miles

Determine the radii of circles with the areas in square miles listed above. Plot those as concentric circles below. Then go back to PART II, CHAPTER 3, UNIT 3.2 and look up the distances of seasonal movements of deer, elk, and other ruminants. Plot one-half the total distances as radii below, comparing distances travelled with radii of wilderness areas of different sizes.

Thes radii of circles represent perfectly circular geometries; actual shapes of wilderness areas result in lesser distances from one border to another.

How do sizes of wilderness areas compare to sizes of ranges used throughout the year? How large must wilderness areas be to be permanent for the different species of wild ruminants?

Additional reference radii are given on the next page.

UNIT 2.4: PARKS, NATIONAL MONUMENTS, AND RECREATION AREAS

Parks, whether they be federal, state, provincial, or county units, are usually set aside for scenic and recreational values, and for non-consumptive uses. They have traditionally been game sanctuaries, not open to public hunting. There are exceptions, of course, and these exceptions have often triggered large-scale controversies.

It is difficult to manipulate park habitats when they are expected to be the least disturbed and most scenic areas around. People are disappointed and upset if they arrive at a park to find visible effects of logging or fire.

A sign in a stand of red pine in Ithaca State Park, Minnesota read for many years, "It took nature 200 years to grow this timber. Fire could destroy it in 2 days." Most of the trees bore fire scars, and people reading the sign felt a protective instinct swelling within them as they inwardly sheltered these monarchs of the forest from further damage and destruction. The park, in fact, was established because of the red pine stands as well as the source of the Mississippi River being there in Lake Itasca. The red pine stands, however, are dependent on fire for their perpetuation! In the absence of fires, regeneration does not take place at a rate sufficient to replace the trees, having instead a heavy shrub layer, primarily *Corylus*, developing. Thus fire suppression in the park would ultimately lead lto the demise of the species for which the park was established. Now that the ecological truth is understood, the sign has been replaced with one declaring the role of fire in certain plant communities, which may be accepted by the general public within a generation or so.

The reason why it is difficult for the public to understand the ecological rationale is that promotion of and protection from fires in different areas may be going on at the same time. Caribou in Wells Grey Park, British Columbia, for example, were declining as a result of fires (Edwards 1954). The role of fire must be evaluated in relation to species being managed for; caribou and red pine react differently to the effects of fire.

State and national parks are an important part of our natural areas, and important ranges for many species of wild ruminants. Management practices necessary for the perpetuation of populations of native species should be implemented on the basis of a thorough understanding of the basic biological relationships involved.

LITERATURE CITED

Edwards, R. Y. 1954. Fire and the decline of a mountain caribou herd. J. Wildl. Manage. 18(4):521-526.

REFERENCES, UNIT 2.4

PARKS, NATIONAL MONUMENTS, AND RECREATION AREAS

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	5---1	95	102	odvi	method increas browse,minn	krefting,lw	1941
JWMAA	6---1	27	30	odvi	deer of allegany st pk, ny	shadle,ar; stullk	1942
NFGJA	3---1	80	87	odvi	hstry,mgmnt,allegany st pk	severinghaus,cw	1956

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CAFGA	23--4	286	289	odhe	notes, calif redwood st pk	orr,rt	1937
WLSBA	4---2	69	73	odhe	odvi, prsc burn, wind cave	lovaas,al	1976

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
ANKIA	51...	2	7	ceel	olympic natl primeval park	ordway,sh,jr	1948
CNJMA	19...	184	192	ceel	mngmnt, elk islnd pk,alber	love,bi	1955
JOMAA	28--1	4	12	ceel	odhe, study,rcky mt nat pk	packard,fm	1947
NAWTA	8----	95	100	ceel	mgmnt, herd reg, yellowsto	cahalane,vh;	1943
NAWTA	27---	191	201	ceel	jcksn hl herd, tetn, yellw	bendt,rh	1962
NPKMA	25---	119,	150	ceel	elk, grand teton natnl prk	murie,oj	1951

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
ORYXA	7---6	301	304	alal	domesticat, russian nat pk	yazan,y; knorre,y	1964

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CZOOA	27...	20	24	rata	cons project in laurentide	desmeules,p	1967
JWMAA	18--4	521	526	rata	fire, decline mt car, b.c.	edwards,ry	1954

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS---------	YEAR
NAWTA	9----	135	143	bibi	restor, wild bis, yellowst	cahalane,vh	1944
TRVIA	108-2	286	304	bibi	ecol and mangmnt, amer bis	fuller,wa	1961
WMBAA	16---	1	52	bibi	mgmnt, wood buffalo nat pk	fuller,wa	1962

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CAFGA	25--2	72	95	ovca	surv, death valley nat mon	dixon,js; sumner,	1939
JOMAA	18--2	205	212	ovca	prelim stud, yellowston pk	mills,hb	1937
NPKMA	33---	7	9	ovca	bighorns of rocky mountain	contor,r	1959
SCBUB	20...	28	31	ovca	way to bring back,yosemite	grinnell,j	1935
tdbc	1----	20	21	ovca	nat park serv, wldl progrm	fredine,g	1957
tdbc	3----	30	32	ovca	status in calif state park	merkel,de	1959
tdbc	7----	58	60	ovca	of lake mead nat recr area	sleznick,j,jr	1963
tdbc	7----	167	168	ovca	in anza borrego desert par	merkel,de	1963
tdbc	8----	1	4	ovca	at san diego zoolog garden	pournelle,gh	1964
tdbc	9----	49	52	ovca	prog rep,josh tree, resrch	welles,re	1965
tdbc	11---	77	79	ovca	curr policy aff man,josh t	dengler,wf	1967
tdbc	12---	38	39	ovca	sprng improvm, death vally	leach,hp	1968
tdbc	12---	50	53	ovca	wldl res, man, josh tree n	dengler,wf	1968
tdbc	13---	86	90	ovca	resrch supp, nat park serv	sumner,l	1969

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
NAWTA	28---	28	45		wldl study, wildl prob,nat prks	leopold,as	1963

OTHER PUBLICATIONS

Carpenter, L. H. and D. L. Baker. 1975. Middle Park cooperative deer study - deer habitat evaluation. In Game Res. Report, July Part 2. Colorado Div. Wildl., Denver. pp. 243-263.

U. S. National Park Service. 1964. 1964-65 pronghorn (antelope) and habitat management plan for Yellowstone National Park. Yellowstone National Park, Wyo. 4 p.

UNIT 2.5: NATIONAL FORESTS

National forests are another designated land area that is subject to different kinds of habitat manipulation practices. Owned by the federal government and managed for timber production, they are not park or wilderness areas. They are also managed with consideration for wildlife values, and hunting is allowed, except in forests or parts of forests where special regulations apply.

The multiple use concept has been applied to national forests, promoting not only tree growth and harvest but also recreation. Thus camping is permitted on national forests, with more primitive campsites available than those found in commercial or park campgrounds. The primitive sites are usually available during the hunting season, and hunters in their pick-up campers and other self-contained recreation vehicles use them.

Habitat management on national forest land is usually a by-product of timber harvest. Questions of clear-cutting compared to selective cutting should take wildlife use into consideration.

REFERENCES, UNIT 2.5

NATIONAL FORESTS

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
JFUSA	34--5	472	474	odvi	for mgt,dee requir,alleghe	ehrhart,eo	1936
JFUSA	52--6	419	422	odvi	correl man with other uses	morriss,dj	1954
JWMAA	5---1	95	102	odvi	meth, increas browse, minn	krefting,lw	1941
JWMAA	35--3	520	532	odvi	mgt criter, oaks, nat fors	goodrum,pd; reid/	1971
VIWIA	9---1	16	18	odvi	new wldl era,virg natl for	mead,cp	1948

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
CAFGA	36--4	343	365	odhe	in chaparral forests,calif	cronemiller,fp; b	1950
JWMAA	15--2	129	157	odhe	in nebraska national fores	mohler,ll; wampo/	1951

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
				rata			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CAFGA	17--2	167	168	anam	on the shasta national for	johnson,fw	1931

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
AMFOA	48...	250	253	ovca	history, hab, pike nat for	spencer,c	1942
tdbca	4----	72	75	ovca	status, angeles nat forest	lewis,a	1960
tdbca	7----	126	32	ovca	of the angeles natl forest	kennedy,ce	1963

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
JOMAA	25--2	149	151	oram	habts, mngmnt, black hills	harmon,w	1944
NAWTA	5----	441	443	oram	rcky mt goats, black hills	swift,lw	1941

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
FOSCA	2....	7	17	biga	popu, nat forests 1921-50	schantz,hl	1956
NAWTA	1----	255	259	wldl	managmnt, national forests	silcox,fa	1936

OTHER PUBLICATIONS

Shantz, H. L. 1939. The bighorn and National Forests. Conservation 5(1): 34-37

TOPIC 3. HABITAT MANAGEMENT PRACTICES

Habitat management practices have been developed and tested over the years to the point where the technological capabilities for manipulating habitat exceeds our understanding of the long range effects of these manipulations. Machines are available for moving earth, changing watercourses, and cutting and handling trees. Fire was used as a management practice by native Americans, and is now staging a comeback as a management practice. Chemicals have been developed which, under certain conditions, can affect large areas of land in very specific ways. Our lack of understanding of long-range effects on habitat is particularly critical with reference to the use of chemicals. These practices are discussed in UNITS 3.1, 3.2, and 3.3.

Good husbandry is good management. Limitations on grazing and browsing is good management. Limitations on grazing and browsing, by controlling animal numbers, and the designation of food production areas are husbandry-type practices discussed in UNITS 3.4 and 3.5.

UNIT 3.1: MECHANICAL

Mechanical practices used in habitat management have changed greatly as a result of technology. The use of manpower and animal power in the early days of logging seems very inefficient to us who are accustomed to powerful tractors and heavy equipment. It is interesting to note that the apparent inefficiency and apparently endless forests resulted in an early but short-lived belief that there was an almost infinite supply of timber available in North America. The effects of settlement and a shift from a hunting society to an agricultural one resulted in much more rapid changes in the habitat than thought to be possible when that shift first began.

Mechanical practices of habitat manipulation have been used for many years. Axes, saws, bulldozers, drag chains . . . all have been used to mechanically alter the habitat. Habitat management practiced now is almost always designed to stimulate regeneration of plants to provide more forage. Cutting practices have been used in Wisconsin to open up the forest, creating openings that provide more summer forage than is found under closed forest canopies (McCaffery and Creed 1969).

Reports of responses of plants to cutting appeared in the Journal of Wildlife Management shortly after its inception in 1937. Cutting is still an effective management practice. Small scale cuttings may be made specifcally for increased browse production. These are often done by volunteer groups, such as hunting clubs, sportsmens groups, boy scouts, etc.

It is more feasible to integrate cutting for browse production with private and commercial timber harvesting. Fuelwood cutting has increased rapidly in the last few years, with openings created in the canopy by the removal of individual trees and openings in the forest by clear-cutting small areas. The extent, distribution, and size of these openings affects their use by deer. McCaffery and Creed (1969) recommend that 3 to 5% of commercial forest land be maintained in openings of about 5 acres, with their locations selected ecologically rather than mechanically.

Large scale commercial forestry cuttings may be designed with wildlife needs in mind. Cutting of larger numbers of smaller but more scattered blocks results in longer perimeters, and that is usually beneficial to wildlife. This may be beneficial to deer, for example, because the habitat offers more variety and choice within smaller areas.

Leopold (1933) formulated the "Law of Interspersion" which emphasized the importance of edges, or borders of different cover types, to game species. Borders, by definition, contain at least two types of habitat, and the more the interspersion of habitat types, the more wildlife expected. Leopold did point out, however, that the benefits of more edges, or more interspersed habitats are most important to game species with low mobility and high type requirements. He specifically cites the buffalo [bison] and antelope [pronghorn] as mobile, one-type game that do not benefit from interspersion.

It is important to realize that the increases in primary production alone may not be beneficial to wild ruminants. The species which invade or increase as a result of mechanical practices are of particular interest, since wild ruminants generally exhibit preferences. Ideally, the most preferred foods should be increased the most, followed by staple foods, with emergency foods and stuffing increased the least (underlined words are terms of Leopold 1933). Such responses by preference category are hard to oc casion; practices should, at least, not result in increased production of the least-preferred foods.

Forage production responses to cutting are described in the serial references listed in this UNIT. A WORKSHEET provides an opportunity to evaluate the increase in perimeter as the number of blocks cut increases and the size of the blocks cut decreases. What is the minimum size of a block cutting in relation to timber-harvesting economics? Another WORKSHEET provides an opportunity to tabulate results and determine costs of mechanical habitat management.

LITERATURE CITED

Leopold, A. 1933. Game Management. Charles Scribner's Sons, N. Y. 481 p. (1961 reprint).

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 3.1

MECHANICAL

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CAFGA	47--2	125	144	od--	manip chamise,range improv	biswell,hh	1961
CAFGA	49--2	95	118	od--	brush manip, wint de range	gibbens,rp; schul	1963
JWMAA	24--4	401	405	od--	forage incr, thinning pine	blair,rm	1960
JWMAA	36--2	595	605	od--	for manip, habitat, sequoi	lawrence,g; biswe	1972
NAWTA	29---	432	438	odvi	chnges, habitat, brush con	box,tw	1964
WSCBA	20--2	18	22	od--	aspen mgt, solut od problm	harrison,rp	1955

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
AMFOA	68--8	24	26	odvi	dinnerbell for the whiteta	hurd,es	1962
JFUSA	59--8	589	591	odvi	prod white-ced brws, loggi	verme,lj	1961
JFUSA	60--1	40	42	odvi	silvic tech, imprv od habi	krefting,lw	1962
JFUSA	68-11	701	704	odvi	improv hab, cut conif swmp	krefting,lw; phil	1970
JWMAA	2---4	206	214	odvi	cuttng imprv wldl env, for	morton,jn; sedam,	1938
JWMAA	3---3	201	202	odvi	thinning for browse	cook,db	1939
JWMAA	5---1	90	94	odvi	mgt sugges, nor wh-ced typ	aldous,se	1941
JWMAA	5---1	95	102	odvi	meth, incr od browse, minn	krefting,lw	1941
JWMAA	20--4	434	441	odvi	mt maple, herbi, cut, fire	krefting,lw; han/	1956
JWMAA	40--4	639	644	odvi	habitat respns, irrigation	dressler,rl; wood	1976
QBMAA	43--4	722	731	odvi	bulldozing, produce browse	gysel,lw	1961
WCDBA	44---	1	104	odvi	signif, forest openi, wisc	mccaffery,kr; cre	1969
WSCBA	17--3	3	11	odvi	feed 'em - with an axe	deboer,sg	1952
XANEA	33---	1	37	odvi	browsing hrdwds, northeast	shafer,el,jr	1965
XFWLA	320--	1	9	odvi	exper plntg food, covr, od	aldous,se	1949

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	30--4	839	841	odhe	topping stim bttrbrsh twig	ferguson,rb; bas	1966

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JRMGA	28--2	120	125	ceel	odhe, graz,improv qual for	anderson,ew; sche	1975

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

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

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
JWMAA	22--1	1	9	ovca	water development, desert	halloran,af; demi	1958

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

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

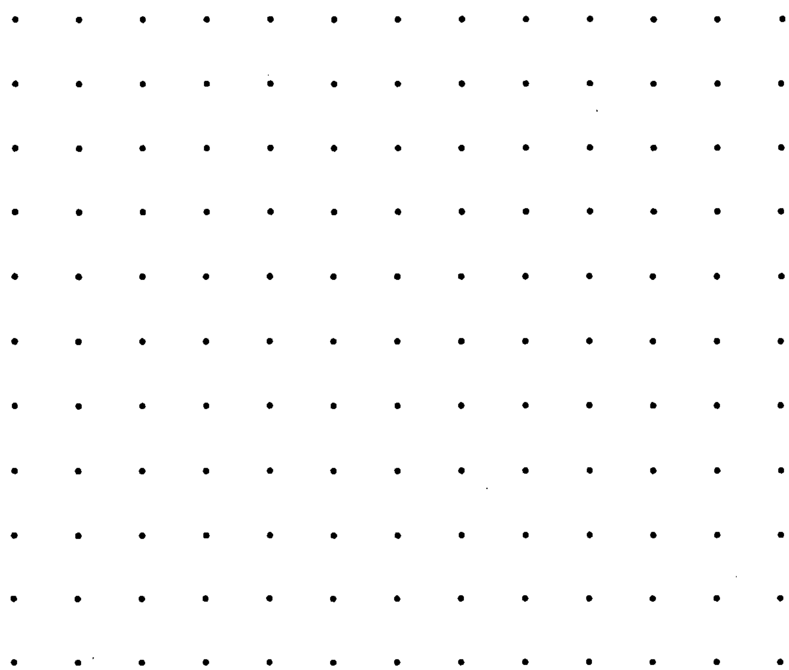
CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
				oram			

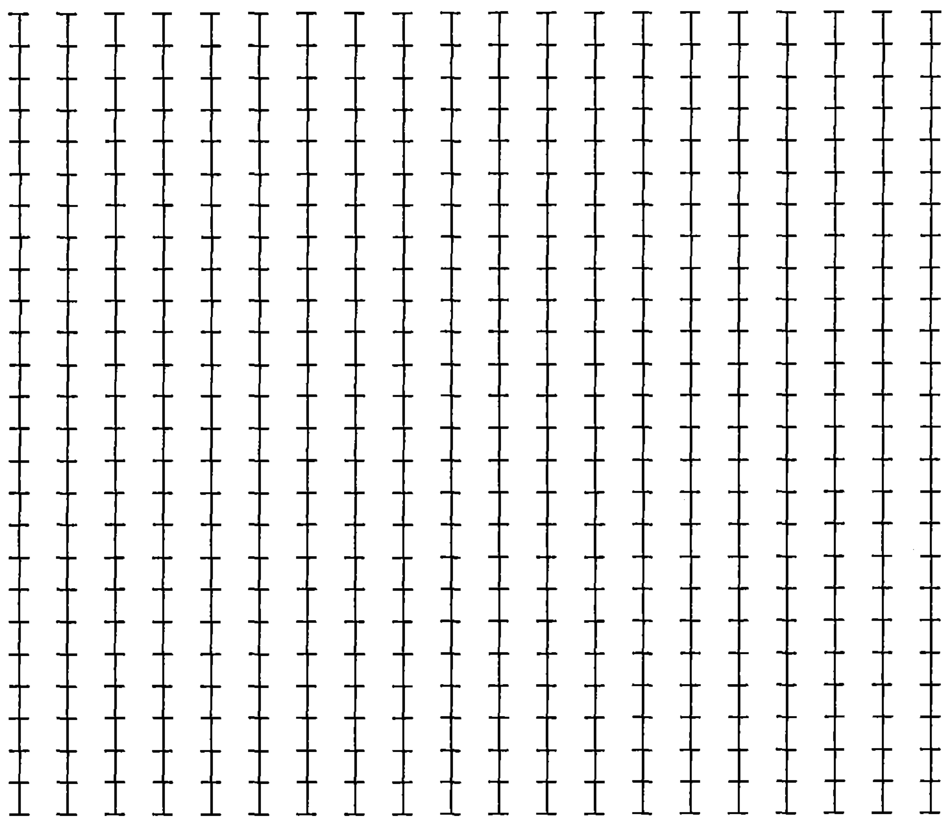
CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
ECOLA	44--2	331	343	----	ecol,water-lev manip, mar	harris,sw; marsha	1963
JWMAA	43--3	807	811	----	disking, herb plnts, seeds	buckner,jl; lande	1979

CHAPTER 21, Worksheet 3.1a

Differences in perimeters due to block size

The dot grid below contains 120 units. Remove 10% of the area by cutting (draw lines between dots and x out the block to indicate cuts), using 1 cut of 12 units, 2 cuts of 5 units each, 3 cuts of 4 units each, 4 cuts of 3 units each, 6 cuts of 2 units each, and 1 cut of 12 units each. Determine the sum of the perimeters for each cutting scheme and plot the results in the grid on the next page.





CHAPTER 21, WORKSHEET 3.1b

Estimating production increases and costs per unit increase, mechanical practices

This WORKSHEET provides a place to tabulate the time spent using mechanical practices to increase forage production, and determine the cost per unit of increase. The questions below are quite general because they apply to a wide range of possible situations described in the literture. Answer them as specifically as possible, and complete the calculations of cost. Note that expected cost rates apply; a projected cost-analysis should include expected costs at the time the work is to be done.

Reference:

Size of area managed?

Forage production prior to managed?

Methods used?

Man-hours required?

Expected rates of pay?

Cost for man-hours?

Machine-hours required?

Expected cost for machine-hours?

Expected total cost?

Forage production after manipulation:

First year?

Second year?

Third year?

Cost per unit weight of forage increase?

Current cost of equivalent amount of cattle feed?

Subjective evaluation of relative cost of wild:domestic ruminant feeding?

(Write a summary on the next page)

UNIT 3.2: FIRE

Fire is a very effective way to manipulate habitat. It has a rapid and drastic effect on the appearance of a plant community, converting it from a living entity to charred ashes, devoid of life, and having the appearance of "ruin." The regularity of wild fires when steam locomotives spewed large volumes of ashes from their mobile smokestacks, along with many other causes of fires, caused considerable concern, resulting in the mobilization of fire prevention forces that have been very effective. One of the greatest impacts such campaigns have had is the psychological impact on people concerning how "bad" fire is.

A plant community that has been burned may look like ruins, but the long-term effect is very different. The burn results in a rapid release of minerals that have been locked up in plant tissue. The canopy opens up, resulting in new quantities of light reaching the soil and becoming available to new growth. The soil is more exposed, with a higher potential for erosion than when the soil was covered with litter and protected by the plant canopy.

Increases in forage production can be dramatic. Diels (1970) reports more than a five-fold increase in the production of green browse per acre two years after a prescribed burning in a mixed pine-hardwood forest in Tennessee, and notes increases in additional studies in Alaska, Minnesota, Virginia, and Isle Royale. The prescribed burns were not intense enough to reduce the ability of the remaining plants to sprout. This is an important characteristic of prescribed burns; they are not enough to damage the plant tissue needed for regeneration.

If undesirable species are to be controlled, then the timing and intensity of the burn is very important. Spring is a good time for burns designed to reduce the vigor of perennial shrubs, after new growth has occurred but before plant reserves have been built up.

Prescribed burns often but not always result in significant increases in forage quality. Protein content of several species were significantly higher after burns at the Patuxent Research Refuge, Maryland (DeWitt and Derby 1955). Other nutrients and chemical constants of the forages were not affected by the controlled fires. The effects now seem to be subject to many variables, and predictions of increases are not always warranted.

Prescribed burns are relatively inexpensive compared to mechanical or chemical methods of reducing above-ground vegetation. The costs are in preparation of fire lanes and fire protection rather than in the technique itself. A WORKSHEET is included for evaluation of the costs of prescribed burning, and the estimates should be compared to those of mechanical practices in WORKSHEET 3.1b.

LITERATURE CITED

DeWitt, J. B. and J. V. Derby, Jr. 1955. Changes in nutritive value of browse plants following forest fires. J. Wildl. Manage. 19(1):65-70.

Dills, G. G. 1970. Effects of prescribed burning on deer browse. J. Wildl. Manage. 34(3):540-545.

REFERENCES, UNIT 3.2

FIRE

BOOKS

TYPE	PUBL	CITY	PGES	ANIM	KEY WORDS------------------	AUTHORS/EDITORS--	YEAR
aubo	mhbc	nyny	584	----	forest fire: control & use	davis,kp	1959
edbo	pnfr	poor	275	----	fire in northern env; symp	slaughter,cw,ed;/	1971

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
CAFGA	47--2	125	144	od--	manip chamise, range impro	biswell,hh	1961
CAFGA	47--4	357	389	od--	brush man,fire,winter rang	biswell,hh; gilma	1961
CAFGA	49--2	95	118	od--	brush manip on winter rang	gibbens,rp; schul	1963
JWMAA	36--2	595	605	od--	for manip, habitat, sequio	lawrence,g; biswe	1972

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
ECOLA	41--3	431	445	odvi	effct fire,growth,repr veg	ahlgren,ce	1960
JFUSA	54--9	582	584	odvi	eff pres burn,for prod,pin	lay,dw	1956
JWMAA	5---1	95	102	odvi	meth, increas browse, minn	krefting,lw	1941
JWMAA	19--1	65	70	odvi	chan,nutr value,brows,fire	dewitt,jb; derby,	1955
JWMAA	20--4	435	441	odvi	mt maple, herbi, cut, fire	krefting,lw; han/	1956
JWMMA	34--3	540	545	odvi	effec prescr burn, de brws	dills,gg	1970
WLSBA	4---2	69	73	odvi	odhe, prescrib burn,s dako	lovaas,al	1976
XANEA	33---	1	37	odvi	browsing hardwds, northeas	shafer,el,jr	1965

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
JWMAA	7---1	119	122	odhe	chapparal sprouts and deer	reynolds,hg; samp	1943
JWMAA	10--1	54	59	odhe	management of black-tailed	einarson,as	1946
JWMAA	41--4	785	789	odhe	ceel, resp cl cut, fire,wy	davis,pr	1977
WLSBA	4---2	69	73	odhe	odvi, prescrib burn, s dak	lovaas,al	1976

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JBRGA	26--4	247	250	ceel	burning veg,grazng,scotlnd	miles,j	1971
JWMAA	36--4	1332	1336	ceel	aerial ignitn, idaho range	leege,ta; fultz,m	1972
NOSCA	53--2	107	113	ceel	eff repeat prscr burn,idah	leege,ta	1979
XARRA	226--	1	4	ceel	od, eff wildfire, ponderos	kruse,wh	1972

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NAWTA	11---	296	308	alal	status moos on isle royale	aldous,se; krefti	1946
NAWTA	18---	539	552	alal	prog,mgmt,south cent alask	spencer,dl; chate	1953
TTFPB	3----	10	33	alal	moose & fire, kenai penins	spencer,dl; hakal	1964

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
ABSZA	30--4	1	44	rata	lichen stands, newfo, rata	ahti,t	1959
JWMAA	18--4	521	526	rata	fire,declin mt car herd,bc	edwards,ry	1954
NAWTA	32---	246	259	rata	effect on, bg car, habitat	scotter,gw	1967

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CAFNA	91--3	282	285	anam	prair fire, prongh, cactus	stelfox,jg; vrien	1977

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
JFUSA	33--3	338	341	doca	relatn grass fire,graz,lon	greene,sw	1935
XATBA	683--	1	52	doca	fire, doca graz, lnglf pne	wahlenberg,wg; g/	1939

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
BOREA	9---9	617	654	----	eff fire,vegetatn,southeas	garren,kh	
ECOLA	13--4	315	327	wldl	factors influnc wldl, cali	stover,ti	1932
ECOLA	30--2	135	145	----	successnl resp herbs, pine	lemon,pc	1949
ECOLA	30--2	223	233	----	ecol role, pne-oak for, nj	little,s; moore,e	1949
ECOLA	34--3	520	528	----	eff on groun covr, pne reg	buell,mf; cantlon	1953
ECOLA	39--1	36	46	----	undergrwth veg, south pine	hodgkins,ej	1958
ECOLA	41--3	431	445	both	effs on repr & grow, minne	ahlgren,ce	1960
JAGRA	50...	809	822	----	eff annual grass fire,long	greene,sw	1935
JFUSA	30--4	419	420	----	burni stimul aspen suckers	shirley,hl	1932
JFUSA	40--2	129	131	----	place of fire, southrn for	conarro,rm	1942
JFUSA	54--9	582	584	----	eff on forage & mast produ	lay,dw	1956
JRMGA	18--4	202	205	----	eff yld, prair brush-savan	vogl,rj	1965
JRMGA	29--1	13	18	----	shrub, herb, 20 yr prescri	lewis,ce; harshba	1976
JWMAA	19--1	65	70	----	change, nutrit valu browse	dewitt,jb; derby,	1955
JWMAA	35--3	508	515	----	sprouting of shrubs, idaho	leege,ta; hickey,	1971
JWMAA	40--3	507	516	----	scrub oak habitat, pennsyl	hallisey,dm; wood	1976
JWMAA	43--3	807	811	----	fire,disk,herb plants,seed	buckner,jl; lande	1979

---- continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NAWTA	3----	376	380	wldl	wildlife forest relationsh	horne,ee	1938
PCGFA	9----	55	60	----	eff burn forag & mast prod	lay,dw	1955
SCIEA	215--	661	663	----	fire eff water,for nutr cy	richter,dd; ralst	1982
SWNAA	23--2	279	288	wldl	eff fire, lodgpol pine for	roppe,ja; hein,d	1978
TTFPB	13---	39	64	hrbv	effs, prscib fire, scotlnd	miller,gr; watson	1973
VILTA	9---3	45	192	wiru	prscb fire,win hbt,lnd use	ahlen,i	1975
XASRA	118..	1	2	----	herb yield, burn flatwo ra	rummell,rs	1958

OTHER PUBLICATIONS

Ralston, C. W. and G. E. Hatchell. 1971. Prescribed Burning Symposium. U.S. Department of Agriculture Southeastern Forest Experiment Station, Asheville, N.C.

Shantz, H. L. 1947. The use of fire as a tool in the management of the brush ranges of California. State Board of Forestry. 156 p.

CHAPTER 21, WORKSHEET 3.2a

Estimating production increases and costs per unit increase, fire

This WORKSHEET provides a place to tabulate the time spent using fire to increase forage production, and determine the cost per unit of increase. The questions below are quite general because they apply to a wide range of possible situations described in the literature. Answer them s specifically as possible, and complete the calculations of cost. Note that expected costs are used; a projected cost-analysis should include expected costs at the time the work is to be done.

Reference:

Size of area burned?

Forage production prior to burning?

Burn methods used?

Man-hours required?

Expected rates of pay?

Expected cost for man-hours?

Machine-hours required?

Expected cost for machine-hours?

Total expected cost?

Forage production after burning:

First year?

Second year?

Third year?

Cost per unit weight of forage increase?

Cost of an equivalent amount of cattle feed?

Subjective evaluation of relative cost of wild:domestic ruminant feeding?

(Write up summary on the next page)

UNIT 3.3: CHEMICAL PRACTICES

Chemicals may be used to stimulate forage production by either direct or indirect means. Ranges with low fertility and depressed total production benefit from the application of chemical fertilizers. Ranges with ample total production but of species not palatable to foraging animals benefit from the application of selective herbicides.

Fertilizers. Experimental application of fertilizers, chemical responses by plants, and selection of browse has indicated that some chemical characteristics of plants are altered in response to fertilizers, and that ruminants show preference for fertilized plants. Nitrogen fertilization resulted in significantly higher crude protein levels in several browse species treated in Maine (Abell and Gilbert 1974). Vegetable yields and crude protein content in Japanese honeysuckle (*Lonicera japonica*) increased, but fruit yields decreased in response to nitrogen fertilization in Arkansas (Segelquist and Rogers 1975). Neither of these two papers report on deer responses to fertilized compared to unfertilized plots, however. The crude protein content of *Quercus undulata* (wavyleaf oak) was not altered by nitrogen fertilizing in a study in New Mexico, but fertilized range showed greater use by mule deer than unfertilized range (Anderson *et al*. 1974).

Herbicides. Growth hormone herbicides were developed rapidly after World War II. They function by stimulating growth to the point where plants "grow to death." One of the early studies on the use of herbicides is reported by Krefting *et al*. (1956) who used 2,4-D and 2,4,5-T to kill the aerial stems of *Acer spicatum* (mountain maple) in order to stimulate regrowth. They cite another study by Roe (1953) which indicated that spraying at the time of bud burst resulted in greater regrowth than spraying during the dormant season. A later study by Krefting and Hansen (1969) showed increased production of better browse plants for white-tailed deer up to six years after spraying with 2,4-D, and deer used the sprayed areas more than control areas when the study was terminated eight years after treatment. The effectiveness of herbicides in selectively controlling and promoting plant growth and forage production is clear enough when short-term effects are evaluated. The important questions about long-term effects, and effects on species other than target species, including non-game species, are major ecological considerations.

LITERATURE CITED

Abell, D. H. and F. F. Gilbert. 1974. Nutrient content of fertilized deer browse in Maine. J. Wildl. Manage. 38(3):517-524.

Anderson, B. L., R. D. Pieper, and V. W. Howard, Jr. 1974. Growth response and deer utilization of fertilized deer browse. J. Wildl. Manage. 38(3):525-530.

Krefting, L. W. and H. W. Hansen. 1969. Increasing browse for deer by aerial application of 2,4-D. J. Wildl. Manage. 33(4):784-790.

Krefting, L. W., H. L. Hansen, and M. H. Stenlund. 1956. Stimulating regrowth of mountain maple for deer browse by herbicides, cutting, and fire. J. Wildl. Manage. 20(4):434-441.

Roe, E. I. 1953. Resprouting of mountain maple after basal spraying with 2,4,5-T. Rec. Rept. Tenth Ann. N. Cent. Weed Cont. Conf.: 73-74.

Segelquist, C. A. and M. J. Rogers. 1975. Response of Japanese honeysuckle to fertilization. J. Wildl. Manage. 39(4):769-775.

REFERENCES, UNIT 3.3

CHEMICAL PRACTICES

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
AGJOA	56--2	223	226	od--	eff fertil grass, deer use	thomas,jr; cospe/	1964
FOSCA	16--1	21	27	od--	brows, ferm doug fir, fert	oh,jh; jones,mb;/	1970

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
FOSCA	16--1	113	120	odvi	uplnd oak resp,fert,n,p,ca	ward,ww; bowersox	1970
JFUSA	60-10	718	719	odvi	dogwood resp nitrogen fert	curlin,jw	1962
JWMAA	5---1	95	102	odvi	meth, increas browse, minn	krefting,lw	1941
JWMAA	20--4	434	441	odvi	mt maple, herbi, cut, fire	krefting,lw; han/	1956
JWMAA	33--4	784	790	odvi	incr brws aer applic 2,4-d	krefting,lw; hans	1969
JWMAA	38--3	517	524	odvi	nutr cont, fertilized brws	abell,dh; gilbert	1974
JWMAA	39--3	259	250	odvi	brows, herbage, intns mngt	wolters,gl; schmi	1975
JWMAA	39--4	769	775	odvi	resp jap honeysckl, fertil	segelquist,ca; ro	1975
NFGJA	15--2	155	164	odvi	fertil, protein, witchhobb	bailey,ja	1968
NCANA	94--	335	346	odvi	eff for fert,prot,ca,p,oak	wood,gw; lindsey,	1967
PSAFA	1960-	103	106	odvi	aer appli 2,4-d, impr brws	krefting,lw; hans	1960
XANEA	33---	1	37	odvi	browsing hardwds, northeas	shafer,el,jr	1965

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JRMGA	30--1	53	57	odhe	ceel, improv rang, sprayng	kufeld,rc	1977
JWMAA	38--3	525	530	odhe	growth, utiliz frtlz brows	anderson,bl; pie/	1974

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JRMGA	16--2	74	78	ceel	chem sgebrsh control distr	wilbert,de	1963
JRMGA	30--1	53	57	ceel	odhe, improv rang, sprayng	kufeld,rc	1977
XARRA	240--	1	4	ceel	sagbrsh cont,herb,calv beh	ward,al	1973

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

alal

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

rata

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

oram

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CAFGA	44--4	335	348	biga	resp brush seedlings, fert	schultz,am; bisw/	1958
CAFGA	48--4	268	281	biga	resp browse plants fertili	gibbens,rp; piepe	1962
CGFPA	28---	1	25	biga	miner fertil, range improv	carpenter,lh; wil	1972
JFUSA	41-12	915	916	----	better acrns fr fertlz oak	detweiler,sb	1943
JFUSA	55-11	803	809	----	silvc prac, wldlf food,cov	gysel,lw	1957
JFUSA	60--1	33	35	biga	fertil, contrl distrb anim	brown,er; mandery	1962
JRMGA	14--3	126	130	----	hrbc eff,nativ forag plnts	mccaleb,je; hodg/	1961
JRMGA	18--6	338	340	----	hrbc veg resp, ozrk woodln	halls,lk; crawfor	1965
JRMGA	25--6	452	456	----	resp prair grass to fertil	rehm,gw; moline,/	1972
JWMAA	30--1	141	151	biga	herbicid trtmt brwse, idah	mueggler,wf	1965
JWMAA	32--3	538	541	biga	herbicd trtmt brwse, 6 yrs	lyon,lj; mueggler	1965
MFNOA	42...	1	2	----	herbici, regrowth mt maple	krefting,lw; hans	1955
MFNOA	66...	1	2	----	wint, spr appl 2,4-d, regr	krefting,lw; hans	1958
MFNOA	95...	1	2	----	imprv brws, aer appl 2,4-d	krefting,lw; hans	1960
NAWTA	21---	127	141	----	herbic, hardwd, brsh contr	goodrum,pd; reid,	1956
NAWTA	27---	384	393	wldl	hrbc appl, south, mangment	chamberlain,eb,j/	1962
PCGFA	30---	656	659	----	fetil oak stimul mast prod	colvin,tr	1976
VILTA	9---3	45	192	wiru	winter habitat, land use	ahlen,i	1975
WLSBA	6---4	259	260	----	frtz eff, bear oak browse	wolgast,lf	1978

OTHER PUBLICATIONS

Stanton, F. W. 1962. Relationship of sagebrush spraying to antelope welfare. Inter. Antelope Confer. Trans. 13: 71-81.

CHAPTER 21, WORKSHEET 3.3a

Estimating production increases and costs per unit increase, herbicides

This WORKSHEET provides a place to tabulate the time spent using herbicides to increase forage production, and determine the cost per unit of increase. The questions below are quite general because they apply to a wide range of possible situations described in the literature. Answer them as specifically as possible, and calculate the expected cost. Note that expected rates apply; a projected cost analysis should include expected costs at the time the work is to be done.

Reference:

Size of area managed?

Forage production prior to application?

Herbicides used?

Cost of herbicides?

Man-hours required?

Expected rates of pay?

Cost for man-hours?

Machine-hours involved?

Cost for machine-hours?

Total expected cost?

Forage production after application?

First year?

Second year?

Third year?

Cost per unit weight of forage increase?

Cost of equivalent amount of cattle feed?

Subjective evaluation of relative cost of wild:domestic ruminant feeding?

(Write summary on the next page)

CHAPTER 21, WORKSHEET 3.3b

Determination of cost of increased quality
of forage due to fertilization

Fertilizing of forest stands may be a costly practice. Fertilied areas often produce higher-quality forages. Nitrogen fertilizer increases crude protein content, for example. The actual cost of the protein increase, expressed on a par unit weight basis lmay be compared to the cost of cattle feed to give an estimate of the cost of management. Answer the following questions to determine the cost.

1. What is the forage production per acre, in pounds or kg per hectare before treatment?

2. What is the protein content, in percent, before treatment?

3. What is the total cost per acre for fertilization?

4. What is the forage production per acre or hectare after treatment?

5. What is the protein content in percent after treatment?

6. What is the difference in percent?

7. To determine the actual cost of the protein from fertilization:

    a. subtract answers in #2 from #5.

    b. multiply the gain (presumably) by the answer to #1.

    c. subtract #1 from #4.

    d. multiply #5 times the answer to c above.

    e. add the answer in d above to b above to get the protein increase.

    f. relate the answer in e above to #3.

    g. compare the cost of cattle feed by calling a local feed store and comparing prices for equivalent units of protein.

UNIT 3.4: LIMITATIONS ON GRAZING AND BROWSING

One way to increase forage production is by preventing excessive grazing or browsing. It is a form of "passive" management, one that recognizes that a proper amount of grazing results in increased forage production, and excessive grazing results in a decline in plant productivity. Grazed plants maintain active growth rather than becoming mature and dormant, resulting in greater actual production than ungrazed plants.

There are optimum foraging intensities and times for different forage species. These have been determined for many of the western range species, but not for the hundreds of different species eaten by white-tailed deer in the eastern United States.

Overgrazing or overbrowsing results in plant reduced vigor and forage production. Complete protection sometimes results in dramatic differences between plant communities outside and inside of exclosures. A small exclosure in the Canadian Rockies, Saskatchewan, protected from elk, was filled with young aspen trees (personal observation, A. N. Moen), while the surrounding area was a grass and sedge meadow.

Exclosures have been set up in many areas, and they demonstrate the impacts that large herbivores have on plant growth and stand composition. Quantitative measurements are not always made in the exclosures available, though they would be very useful to have for comparisons of growth and forage production inside and outside. Also, many small exclosures would be better than few large ones, with the exclosures located in different habitat types. Measurements of production inside and outside the exclosures should be made regularly and analyzed in relation to weather and growing conditions and to herbivore population densities.

REFERENCES, UNIT 3.4

LIMITATIONS ON GRAZING AND BROWSING

BOOKS

TYPE	PUBL	CITY	PGES	ANIM	KEY WORDS-----------------	AUTHORS/EDITORS--YEAR
edbo	acpr	nyny	718	hrbv	herbiv: interac w/plnt met	rosenthal,ga,ed;/ 1979

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CAFGA	40--3	215	234	od--	deer-fora rel lassen-washo	dasmann,w; blaisd	1954
ECOLA	51--6	1088	1093	od--	long term exclusn, pne for	ross,ba; bray,jr/	1970
JFUSA	47-11	909	913	od--	effect conifer repro, mont	adams,l	1949
JFUSA	48-10	675	678	od--	deer in reln plnt successn	leopold,as	1950
JFUSA	56--2	116	121	od--	stand dens, od brws, adiro	curtis,ro; rushmo	1958
JFUSA	64--5	322	326	od--	eff sim od brows, doug-fir	crouch,gl	1966
NAWTA	15---	571	578	od--	deer in reln plnt successn	leopold,as	1950
NAWTA	23---	478	490	od--	deer exclosure exper, mich	graham,sa	1958
NYCOA	5---3	6	8	od--	what's happen to deer rang	darrow,rw	1950
PCGFA	2....	1	6	od--	evaluation of deer browsin	goodrum,p	1948
PZESA	8----	52	54	od--	effect,subalpn for & scrub	wardle,p	1961
TAGPA	3....	10	12	od--	react, popul, grazng prac	merrill,lb; teer/	1957
XANEA	33---	1	37	od--	brwsng hardwoods, north es	shafer,el,jr	1965

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JAPEA	16--3	855	861	odvi	influ on struc & comp for	anderson,rc; louc	1979
JFUSA	54--6	391	398	odvi	effct matur n hrdwd forest	webb,wl; king,rt/	1956
JFUSA	64-12	801	805	odvi	influ logged n hrdw forest	tierson,wc; patr/	1966
JWMAA	5---1	90	94	odvi	mgt sugges, nor wh-ced typ	aldous,se	1941
JWMAA	10--1	60	63	odvi	summr browse, cut-ovr hrdw	cook,db	1946
JWMAA	16--4	401	409	odvi	brows study, lake sta	aldous,se	1952
JWMAA	21--1	75	80	odvi	effct repro, heml-hardwood	stoeckeler,jh; s/	1957
JWMAA	24--1	68	80	odvi	influence on vege, wiscons	beals,ew; cottam,	1960
JWMAA	24--4	387	395	odvi	deer-fore habita reln, ark	halls,lk; crawfor	1960
RWLBA	7---1	1	61	odvi	eff, adirndack forest typs	pearce,j	1937
XANEA	308--	1	8	odvi	impact on hardwood regen	marquis,da	1974
XFNNA	87---	1	4	odvi	hickory run deer exclosure	grizez,tj	1959

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
NOSCA	52--3	233	235	odhe	deer & forest reprod, wash	amaral,m	1978

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
JRMGA	18--4	218	220	ceel	doca, respns plnt spec, wy	jones,wb	1965
JWMAA	5---4	427	453	ceel	effect wintr brwsng, monta	gaffney,ws	1941
NOSCA	34--1	25	36	ceel	response, graz, gras & shr	smith,dr	1960
PASCC	22---	23	24	ceel	influ elk dist, graz, vege	ashby,kr	1971

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
AMNAA	95--1	79	92	alal	impct of browsng borea for	snyder,jd; janke,	1976
JWMAA	32--4	729	746	alal	damage, fir-wh bir, newfnd	bergerud,at; manu	1968
LESOA	3....	67	73	alal	effect forest regen, ussr	baleishis,rm; pad	1975
LESOA	3....	74	79	alal	effect undrgro, bush woo	yanushko,ad; duni	1975

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
ABSZA	30--4	1	44	rata	lichen stands, newfoundlnd	ahti,t	1959
JWMAA	32--2	348	367	rata	introduc, increase & crash	klein,dr	1968

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
tdbca	10---	71	77	ovca	mult use coord, san gorgon	graham,h	1966

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
JAPEA	12--1	25	29	doca	nutr remov, doca, sh gr pr	dean,r, ellis,je/	1975
XATBA	683--	1	52	doca	fire, doca graz, lnglf pne	wahlenberg,wg; g/	1939

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
BRYOA	81--2	294	306	graz	lichens, tundr transit are	kershaw,ka	1978
BSETB	41--1	85	94	brws	effs grazng, browsg on veg	nicholson,ia	1970
CPLSA	41--3	615	622	graz	comp light gr, ungr grassl	johnston,a	1961
ECOLA	21--3	381	397	graz	effe overgr & erosn, prair	smith,cc	1940
ECOLA	35--2	200	207	graz	eff compos & prod, prairie	keating,rw	1954
FOSCA	1....	61	67	brws	eff brws, qual hardw, mich	switzenberg,df	1955
FRCRA	34--1	21	24	brws	infl brwsng anims, regener	de vos,a	1958
JFUSA	48--2	118	126	graz	chng pond pne bnchgras rng	arnold,jf	1950
JFUSA	67-12	870	874	brws	grwt, dev brwsd mapl seedl	jacobs,rd	1969
JFUSA	68--5	298	300	brws	brwsng, hrdwd regen, appal	harlow,rf; downin	1970

continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
JRMGA	11--4	186	190	biga	exclosures, manageme, utah	young,s	1958
JRMGA	23--2	95	97	graz	effec tramplng, graz, lich	pegau,re	1970
JRMGA	25--6	426	429	graz	clippng effects utah range	drawe,dl; grumbl/	1972
JWMAA	3---1	1	13	----	electric fence in wldl man	mcatee,wl	1939
JWMAA	3---4	295	306	brws	yellowst wint rnge studies	grimm,rl	1939
JWMAA	17--4	487	494	brws	eff sim od damag, conifers	krefting,lw; stoe	1953
JWMAA	30--3	481	488	brws	eff simul & naturl, mt map	krefting,lw; ste/	1966
JWMAA	32--4	769	772	brws	surv, grwt brwsd bittrbrus	ferguson,rb	1968
NAWTA	19---	526	533	brws	chang n mich frsts, brwsng	graham,sa	1954
UASPA	32---	65	69	biga	exclosures, manageme, utah	young,s	1955
WSCBA	18--1	3	10	brws	and the browse came back	deboer,sg	1953
XFNNA	33---	1	3	brws	wh-cedar eliminatd by, n j	little,s; somes,h	1965
ZORVA	32...	67	70	brws	browsing shrub vegetation	stalfelt,f	1970

OTHER PUBLICATIONS

ZoBell, R. S. 1963. Background of the Wyoming antelope fencing study. Inter. Antelope Confer. Trans. 14: 61-66.

Rouse, C. H. 1962. Antelope and sheep fences. Inter. Antelope Confer. Trans. 13: 45-47.

Interstate Antelope Conference. 1962. Recommended specifications for barbed wire fences (for benefit of livestock and wildlife). Inter. Antelope Confer. Trans. 13: 100-101.

UNIT 3.5: FOOD PRODUCTION AND WATERING AREAS

Food production areas are established when the primary management objective is production of more forage. Such an objective is valid when forage is an important limiting factor.

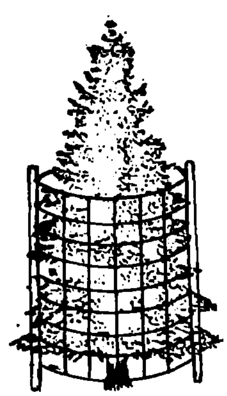
Food production may be increased by increasing the number of food-producing plants and by increasing the production of existing plants. Both can be accomplished at the same time in some areas, and in others, one of the two is used alone.

Reseeding is a commonly-used management practice for increasing forage production. This practice is used on large areas in the Western States, with "chaining" used to prepare the soil surface and destroy shrubby vegetation, followed by seeding of grasses using airplanes to broadcast the seed, and then "back-chaining," or chaining again to cover the seed and further clear the land.

Reseeding is used on a smaller scale in the Lake States and in the Northeast, where small (an acre or so) log-landings are often seeded to hasten the recovery of vegetation. Research at the Arnot Forest, Cornell University, has shown that the recovery rate by natural succession is very site-related; if soil conditions are good for growth, natural revegetation is rapid and seeding is not necessary. If particular species are desired in the early stages of succession, then reseeding will be necessary, of course.

Production by existing plants can be stimulated by cutting of those species that produce suckers, and by opening up closed canopies to allow more light to reach species in the understory that are light-limited. Clear-cutting or selective cutting are both effective ways to set back succession and stimulate forage production.

A rather intensive method of increasing food production by white cedar has been demonstrated by Severinghaus and Sharick (1980). Wire netting (4-inch mesh) cylinders 34 inches in diameter and 60 inches high are placed around 2 to 4-foot high white cedars that have been planted, supported by two steel posts. As the trees grow, their leaves reach the wire mesh and pass through. The deer can also reach into the cylinders, but not far enough to browse too heavily on the cedar.



Production per cylinder averaged between 1.28 and 2.88 pounds of fresh-weight forage per year, which, with 300 cylinders per acre, results in 384 to 864 pounds of forage per acre per year. This is considerably more than the forage production in many forest stands. Further, white cedar is high quality forage. Additional forage is produced between the cylinders too, of course.

Food production areas become rather expensive, and every effort should be made to establish them only where necessary, where plant growth is assured, and where they will be protected from the effects of overuse. They should not be counted on to support large populations of wild ruminants; natural production of forage is necessary for productive free-ranging populations.

LITERATURE CITED

Severinghaus, C. W. and W. N. Sharick. 1980. Winter deer feeders. The Conservationist 35(3):10-13.

REFERENCES, UNIT 3.5

FOOD PRODUCTION AND WATERING AREAS

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CAFGA	47--2	125	144	od--	manip chamise, rang improv	biswell,hh	1961
CAFGA	49--2	95	118	od--	brush manip on winter rang	gibbens,rp; schul	1963
CAGRA	7....	4	....	od--	planting to reduce damage	longhurst,wm	1953
IGWBA	3....	1	61	od--	improv winter rang, revege	holmgren,rc; basi	1959
JFUSA	67-11	803	805	od--	improv habitat, s w forest	reynolds,hg	1969
JWMAA	2---1	1	2	od--	preventing deer concentrat	cox,wt	1938
JWMAA	24--4	401	405	od--	forage incr, thinning pine	blair,rm	1960
MOCOA	12...	4,5	13	od--	food planted with an axe	dunkeson,r	1951
NAWTA	3----	403	410	od--	experimental feeding of de	nichol,aa	1938
NAWTA	13---	431	441	od--	meth, measr deer range use	mccain,r	1948
WSCBA	20--2	18	22	od--	aspn mgt,solut deer problm	harrison,rp	1955

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
AMFOA	68--8	24	26	odvi	dinnerbell for the whiteta	hurd,es	1962
JFUSA	59--8	589	591	odvi	prod white-ced brws, loggi	verme,lj	1961
JFUSA	60--1	40	42	odvi	silvicult tech, improv hab	krefting,lw	1962
JRMGA	23--3	213	214	odvi	growng food admist s timbr	halls,lk	1970
JWMAA	5---1	90	94	odvi	man sugg, north white ceda	aldous,se	1941
JWMAA	5---1	95	102	odvi	methods of increasng brows	krefting,lw	1941
JWMAA	18--4	531	533	odvi	result ccc plantings, mich	dobie,jg; marshal	1954
JWMAA	20--4	434	441	odvi	stim regrow mt map, herbic	krefting,lw; han/	1956
JWMAA	33--4	784	790	odvi	incr brws aer applic 2,4-d	krefting,lw; hans	1969
JWMAA	40--4	639	644	odvi	habitat respons,irrigation	dressler,rl; wood	1976
NAWTA	9----	144	149	odvi	determ carr cap deer yards	davenport,la; sh/	1944
NAWTA	18---	581	596	odvi	deer yard carr cap, browse	davenport,la; sw/	1953
NAWTA	22---	501	519	odvi	exprm deer yrd mgt, n hamp	laramie,ha,jr; do	1957
NFGJA	8---1	19	30	odvi	seeding herbaceous perreni	webb,wl; patric,e	1961

odvi continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NYCOA	Dec-J	8	9	odvi	winter feedng, good or bad	hesselton,wt	1964
PCGFA	13---	21	34	odvi	range anal, mgt implicatns	adams,wh,jr	1959
PSAFA	1947-	210	214	odvi	cedar swamp mgmnt and deer	bartlett,ih	1947
PSAFA	1965-	229	233	odvi	sustaind yield, woody brws	shaw, sp; ripley,	1965
QBMAA	43--4	722	731	odvi	bulldozing, produce browse	gysel,lw	1961
WLSBA	4---4	186	188	odvi	greenbrier, silvicult trtm	maxey,wr	1976
WLSBA	6---4	212	216	odvi	mgmt bur oak, winter range	severson,ke; kran	1978
WSCBA	20--2	18	22	odvi	aspen mgt,solutn deer prob	harrison,rp	1955
XFWLA	320--	1	9	odvi	exper planting food, cover	aldous,se	1949

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	8---4	317	338	odhe	supplem winter feedg, utah	doman,er; rasmuss	1944
JWMAA	30--4	839	841	odhe	toppng stim bittrbrsh twig	ferguson,rb; bas	1966

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JRMGA	28--2	120	125	ceel	odhe,graz, improv qual for	anderson,ew; sche	1975
JRMGA	30--1	53	57	ceel	odhe, improv rang, sprayng	kufeld,rc	1977

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

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

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
JWMAA	22--1	1	9	ovca	water development, desert	halloran,af; demi	1958
tdbca	2----	28	31	ovca	watr dev,kofa & cabeza ran	kennedy,ce	1958
tdbca	6----	41	48	ovca	range improv meth and prac	yoakum,j	1962
tdbca	7----	185	192	ovca	summr waterhole study, cal	knudsen,mf	1963
tdbca	9----	53	54	ovca	a habitat management plan	schneegas,er	1965
tdbca	10---	53	55	ovca	proposed rang devl project	call,mw	1966
tdbca	13---	14	21	ovca	desert habitat mangmt plan	warburton,jl	1969
tdbca	13---	103	107	ovca	stubbe sprng guzzler,water	baker,jk	1969

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
CAFGA	38--4	453	484	----	mgt chamise brshlnds,calif	biswell,hh; tabe/	1952
CAFGA	48--1	49	64	game	manip shrb form, brws prod	gibbens,rp; schul	1962
ECOLA	44--2	331	343	----	ecol,water-levl manip, mar	harris,sw; marsha	1963
JFUSA	30--4	129	131	----	burni stimul aspen suckers	shirley,hl	1932
JFUSA	41-12	915	916	----	better acrns fr fertlz oak	detweiler,sb	1943
JFUSA	55-11	803	809	----	silvc prac, wldlf food,cov	gysel,lw	1957
JFUSA	60--1	33	35	biga	plant,fert,control distrib	brown,er; mandery	1962

---- continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	2....	79	81	game	use salt, control distribu	case,gw	1938
JWMAA	43--3	807	811	----	fire,disk,herb plants,seed	buckner,jl; lande	1979
MFNOA	79...	1	2	wldl	survivl, grwth, cover plnt	krefting,lw	1959
NAWTA	30---	285	296	----	brush mgt tech, forag, tex	box,tw; powell,j	1965
NAWTA	33---	217	222	----	game food plntngs, s fores	____; stransky,jj	1968
PCGFA	30---	656	659	----	fertilz oak stim mast prod	colvin,tr	1976

CHAPTER 21, WORKSHEET 3.5a

Forage production cylinders and metabolic energy produced

The forage production cylinders described by Severinghaus and Sharick (1980) represents an intensive management practice that might be used in local areas. Revise the cost estimate based on current prices, and then convert the total cost from a "per pound of forage" basis to a "per megacalorie metabolizable energy" basis. Refer to PART IV, CHAPTER 11, TOPIC 3 for digestibility and metabolizable energy coefficients for white cedar or the species of your choice. Answer the following questions pertaining to costs per cylinder:

Netting cost?

Steel posts?

Labor?

Cost per tree?

Total cost per cylinder?

Expected forage production in kg per cylinder?

Digestible energy per kg of forage?

Metabolizable energy per kg of forage?

Cost per megacalorie of metabolizable energy?

Number of cylinders per acre?

Megacalories per acre?

Equivalent deer-days of metabolism for a 60 kg deer at 1.75 MBLM?

LITERATURE CITED

Severinghaus, C.W. and W.N Sharick. 1980. Winter deer feeders. The Conservationist 35(3):10-13.

UNIT 3.6: SUPPLEMENTAL FEEDING

The feeding of deer and other wild ruminants in the winter has been a controversial practice. Controversies have focused on whether deer will eat hay and grain fed to domestic ruminants (they will), whether they can digest such foods or not (they can), whether it is too expensive for the returns (it can be very expensive), and whether or not it is ecologically desirable. The last "whether" is best answered by more than a parenthetical expression.

The feeding of wild ruminants is not ecologically "natural" in the sense that populations thrived without supplemental feeding for centuries before settlement. The feeding of bison in Custer State Park, South Dakota prevents them from wandering "naturally" during the winter, seeking areas with less snow cover, but it is necessary to keep the herd of over a thousand animals in a fairly restricted area, relative to bison psychology. The feeding of white-tailed deer in New York State is different; the animals are distributed throughout the state, and the deer populations are very high in some areas. So high, in fact, that winter mortality from starvation occurrs almost annually in some areas. Should such deer be fed?

The answer to the last question is not simple, unless one looks at only one framework for answers. Ecologically, the answer is no. Ecological alternatives to the high population include increased hunting pressure and removal of more females from the population to reduce population growth.

Socially, the answer is yes to some people. They like to see deer, and they like to feed them. Further, snow depths sometimes limit movement so much that deer are concentrated much more than usual, which results in starvation even if good management practices have been carried out. The problem with making decisions on such bases is that such decisions can hardly be reversed the next year when conditions might be much improved for the deer. People do not reverse their thinking very fast.

Hunting clubs and private parks are going to feed deer regardless of the arguments for or against this practice (Statement by Paul Smiths Fish and Game Club, 1970, mimeo). Given that premise, how should feeding be carried out?

The supplemental feed should be provided before nutritional problems appear. The animals need time to become accustomed to the new feed; microorganism populations will shift as new substrates become available in the rumen.

Corn, pelleted grains, and leafy hay will be consumed by deer, and they will derive nutritional benefits from such foods.

The food should be supplied in areas where cover is also available, and it should be spread out over larger areas to avoid concentration of animals and to provide subdominant animals more opportunity to access the food.

Feeding must continue once it has started. The high cost of the feeds and the man-hours needed to provide it regularly will make the total cost of a supplemental feeding program rather high.

If supplemental feeding is not accompanied by herd control or, better yet, herd reduction, the need for supplemental feeding will likely increase, with escalating costs and potentially more biological problems as a result of concentrating the animals.

Having worked with deer for about 20 years, I feel an obligation to present my best professional judgement concerning supplemental feeding of deer. I do not recommend it, preferring rather to see efforts directed toward controlling herds to levels that are within the carrying capacity of the range.

What is the carrying capacity of a particular range? Calculations in PART VI call attention to the parameters necessary in order to evaluate carrying capacity using known biological knowledge. I also prefer to use a safety margin on the side of the range, keeping deer populations to less than rather than more than what the range could support under average conditions. I think that carrying capacity should be based on expected conditions in at least 19 out of 20 years. In other words, accept the effects of a 1 in 20 winter, but be conservative enough to hold deer populations down so problems will not appear, on the average, every 19 years. Further, if I were asked to reconsider my recommendation, it would be even more conservative (1 in 30 or more).

I do recognize that local situations surrounding particular species may need special attention. The recommendation above is for well-established populations subjected to regulated hunting.

It is also important to realize that weight loss during the winter is normal for wild, free-ranging ruminants. The annual weight cycle (See PART I, CHAPTER 1, UNIT 1.4) includes weight losses as a result of the mobilization of fat reserves. Further, the metabolic depression, an adaptation for survival in the winter, reaches a minimum in February (See PART III, CHAPTER 7, TOPIC 6), so if winter ends in March and early April, ecological metabolism has not yet risen so high that it cannot be met under normal early spring range conditions. Since the timing of the arrival of spring cannot be predicted in early winter when feeding must start, the duration of supplemental feeding is unknown, and the worst case should be expected.

Separate the biological from the social issues when confronting questions of supplemental feeding, and allow the emotions to have some input only into the social ones. There is sufficient knowledge available to evaluate biological considerations, and they should be presented as the framework within which social issues may be argued.

REFERENCES, UNIT 3.6

SUPPLEMENTAL FEEDING

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
AMFOA	51--1	13	15	od--	killing deer by kindness	carhart,ah	1945
JWMAA	39--4	813	813	od--	wntr fld test, suppl blcks	anderson,rh; you/	1975
NAWLA	7---1	46	47	od--	feeding deer to death	giles,rh,jr; mcki	1968
NAWTA	8----	333	337	od--	fallacies in winter feedng	carhart,ah	1943

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CNSVA	19...	8	9	odvi	winter deer feeding	hesselton,wt	1964
JWMAA	39--4	813	814	odvi	wint field test,food block	anderson,rh; you/	1975
NAWTA	4----	268	274	odvi	results, feeding exp, mich	davenport,la	1939
NYCOA	2---4	21	21	odvi	winter deer feeding	darrow,rw	1948
WSCBA	14---	18	19	odvi	deer starv at feedng statn	stollberg,bp	1949

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	8---4	317	338	odhe	supplmntl wint feedng, uta	doman,er; rasmuss	1944

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JRMGA	4---4	279	280	ceel	elk mngmnt problms,montana	cooney,rf	1951
JRMGA	5---1	3	7	ceel	elk problems in montana	cooney,rf	1952
NEJZA	26--3	448	448	ceel	ecolo, wint feedng, sctlnd	wiersema,gj	1976

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

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

rata

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

oram

CHAPTER 21, WORKSHEET 3.6a

The cost of supplying feed to wild ruminants

The cost of supplying feed to wild ruminants may be calculated quite easily by determine the cost of each component of the feeding operation and summing them up. A list of questions is given below which will aid in cost determination.

The next WORKSHEET includes questions on population changes as a result of supplying feed, with the cost represented on a "per animal increase" basis. Both of these WORKSHEETS should be completed in order to arrive at the true cost of supplemental feeding.

Amount of feed provided?

Cost of feed provided?

Man-hours required to feed?

Cost per man-hour?

Machine-hours required to feed?

Cost per machine-hour?

Feeding station equipment needed?

Cost of feeding station equipment?

Complete the calculations and write a summary statement of the total cost in the space below.

CHAPTER 21, WORKSHEET 3.6b

The cost "per animal increase" of feeding wild ruminants

The total cost of providing feed, calculated in the previous WORKSHEET, should now be divided by the population increase that can be attributed to supplemental feeding to determine the cost "per animal increase." The best way to determine the increase is to go back to PART VI, CHAPTER 19 and review the factors affecting population changes and predictions. Then, use the appropriate WORKSHEETS in CHAPTER 19 to make the calculations necessary for predicting population changes as a result of this particular managment practice. Predict the number of animals present in the fall population with no supplemental feeding, and with supplemental feeding. The difference is the net increase in the population. Divide that number into the total cost of feeding to determine the cost per animal increase. Summarize your results below.

The cost per animal increase in the population is one thing, and the cost per animal harvested as a result of supplemental feeding is another. Suppose that the annual harvest equals one-third of the population. The cost per animal harvested is then three times the cost per animal increase. Redo your calculations of cost in relation to the harvest rate and summarize your results below.

TOPIC 4. COMMERCIAL PRIORITIES

Commercial priorities are higher than wildlife priorities whenever the commercial enterprise is the basis of perpetuating the resource. Agriculture and forestry are two such enterprises in the United States and Canada.

Agriculture involves the raising of cultivated crops and domestic animals for sale. Crops raised include annuals, such as small grains and row crops, short-term perennials, such as hay, and long-term perennials, such as orchards and vineyards. All of these crops are subject to potentially large damages from grazing and browsing animals.

Forestry is a long-term enterprise that may be very much affected by wild ruminant populations. Foraging ruminants affect the establishment of seedlings, they damage saplings by rubbing antlers, and they forage on the terminal buds on both axillary and lateral stems until the trees have grown out of reach.

Relationships between wild ruminants and agriculture and forestry are discussed in the next two UNITS, respectively.

UNIT 4.1: AGRICULTURE

White-tailed deer, mule deer, and elk are the wild ruminant species which have the most potential for causing damage to agricultural crops because they live in areas with intensive farming and ranching, and they are rather adaptable animals.

Elk will damage vegetable gardens, pastures, grainfields, corn fields, orchards, and haystacks (Murie 1951). Some damage may approach total destruction, as in gardens, and some is a sharing of resources, such as pastures.

Mule deer affect the composition of the range by their grazing. Perennial forbs were much more prominant and perennial grasses were more prominant in an area from which livestock were excluded than in an area grazed by livestock. Much of the sagebrush was killed by deer browsing, while plants were much more vigorous and abundant in the livestock pasture (Smith 1949).

White-tailed deer damaged cherry orchards in Michigan very severely (Ruhl 1956). Eleven kinds of fruit trees and shrubs are listed by Cowan (1956) as being part of damage complaints in British Columbia, plus thirteen other kinds of fruit, vegetable, and flower crops, an "obviously incomplete list." Fruit trees are particularly vulnerable to deer damage, with truck crops and forage crops less vulnerable overall but still subject to potentially heavy local damage.

What kind of protection can be provided agricultural crops? Farms and ranches cannot be fenced with deer- or elk-proof fences due to cost considerations. Orchards and gardens, high-density crops, may be fenced, but suitable fencing is very expensive even for small areas. Fencing is about the only sure way to keep deer out, however. Electric fences, though much less expensive than netting, are subject to loss of electrical current and breakage. The current may be shorted out by growing vegetation, and it is shorted out during rainy weather. Electric fence may be easily broken by animals running into it as the wire is light weight. It is generally not reliable enough to protect valuable crops.

Many repellants have been tried. These have been generally unacceptable, and there are practical problems with their use. Rains dilute repellents and wash them off, for example.

LITERATURE CITED

Cowan, I. M. 1956. Life and times of the coast black-tailed deer. Pages 523-617. In The Deer of North America, W. P. Taylor, Ed. The Stackpole Company, Harrisburg, Pa. 668 p.

Murie, O. J. 1951. The Elk of North America. The Stackpole Company, Harrisburg, Pa. 376 p.

Smith, A. D. 1949. Effects of mule deer and livestock upon a foothill range in northern Utah. J. Wildl. Manage. 13(4):421-423.

REFERENCES, UNIT 4.1

AGRICULTURE

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NZFTA	51---	1	27	cerv	chem contrl n z, intr deer	daniel,mj	1966

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
AMFGA	68-11	13,18,26		od--	orchards versus deer	berry,rn	1948
CAFGA	18--2	136	147	od--	damage to crops in califor	true,g,jr	1932
CAFGA	43--1	100	102	od--	an outriggr type deer fenc	blaisdell,ja; hub	1957
CGFPA	12---	1	22	od--	lit review, orchard damage	harder,jd	1968
FHSCA	16--4	78	82	od--	control deer damages, utah	low,jb	1955
JFUSA	57--1	42	43	od--	a low-cost deer fence	grisez,tj	1959
JFUSA	65--8	564	566	od--	attrctnts, appr damag prob	dasmann,rf; hubb/	1967
JWMAA	22--3	325	326	od--	overhanging deer fences	jones,mb; longhur	1958
JWMAA	27--1	129	132	od--	stream cross struct, fence	blair,rm; /	1963
JWMAA	29--4	885	888	od--	deer fenc construc & costs	halls,lk; boyd,c/	1965
NAWTA	33---	169	181	od--	ceel, influ cattle mgmt on	skovlin,jm; edge/	1968
SCIEA	92---	529	530	od--	electric fences, repel dee	burr,jg	1940
TAGPA	3---5	10	12	od--	react deer pop, graz pract	merrill,lb; teer/	1957
TIMBA	56--1	48	51	od--	increasng problm of damage	anonymous	1955

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
BICOB	6---1	69	70	odvi	morganza floodway opening	yancey,rk	1974
CBTIA	15...	411	420	odvi	zinc dimeth repllnt, crops	baumgartner,ll; p	1949
CNBUA	348--	1	16	odvi	deer herd, land owner,conn	mcdowell,rd; bens	1960

odvi continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	38--3	488	498	odvi	behav respn,intnsv ranchng	hood,re; inglis,j	1974
NAWTA	14---	567	576	odvi	crop protct repllnt, maine	powell,se	1949
NAWTA	14---	604	611	odvi	damage control, herd mgmnt	bump,g	1949
PCGFA	15---	119	122	odvi	new princ, prevnt crop dam	flyger,v; thoerig	1961
PCGFA	16---	45	52	odvi	crop damage, dee, maryland	flyger,v; thoerig	1962
PCGFA	20---	15	18	odvi	forage anal, mngmnt studie	short,hl	1966
PCGFA	20---	233	235	odvi	repell,gardn,orch,field,va	carpenter,m	1966
PCGFA	21---	32	38	odvi	damage, citrus grovs, flor	beckwith,sl; stit	1967
TISAA	57--3	179	181	odvi	effe soybean plants, illin	klimstra,wd; thom	1964
VIWIA	16--2	25	25	odvi	bone tar oil sprays, repel	virginia commissi	1955
VIWIA	28--5	8	9	odvi	control of deer damage	carpenter,m	1967
WLSBA	5---3	107	112	odvi	damag orchards, better mgt	anthony,rg; fishe	1977
WLSBA	6---4	235	239	odvi	willing farmrs incur damag	brown,tl;o decke/	1978
WLSBA	6---4	250	253	odvi	characts damage to soybean	decalesta,ds; sch	1978
WSCBA	4---6	41	46	odvi	damag, brule r valley, wis	welsh,s	1939
WSCBA	10--3	15	15	odvi	bear, damage payments, wis	anonymous	1945
WSCBA	16-10	10	13	odvi	deer repellent tests, wisc	thompson,dr; keen	1951
WSCBA	18--1	3	10	odvi	--and the browse came back	deboer,sg	1953

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CAFGA	18--2	156	165	odhe	repellents & deer control	true,gh,jr	1933
CAGRA	5---9	7	7	odhe	deer repellents, californi	howard,we; hjersm	1951
CAGRA	7---2	4	4	odhe	plntng to reduce damag, ca	longhurst,wm	1953
CAGRA	10--5	4,	10	odhe	mngng on private land, cal	longhurst,wm; how	1956
JFUSA	48--1	26	30	odhe	wildl-forst relatns, pacif	mitchell,ge	1950
JFUSA	67-11	803	805	odhe	improvm habitat, s w lands	reynolds,hg	1969
JWMAA	13--4	421	423	odhe	lvstck, eff on range, utah	smith,ad	1949
UAECA	121--	3	17	odhe	deer mgt, rang lvstck prod	stoddart,la; rasm	1945

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NAWTA	33---	169	181	ceel	od,doca,influenc cattl man	skovlin,jm; edge/	1968
SFORA	18--3	184	188	ceel	longev synth twine, nettng	neustein,sa	1964

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
MRLTA	38--1	1	3	alal	dammed waters, moose range	edwards,ry	1957

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NAWTA	12---	185	192	anam	range use in western texas	buechner,hk	1947
TRVIA	108-2	266	285	anam	reg numbrs, relat 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
				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
JRMGA	7---4	170	175	dosh	doca, optim use summr rang	hopkin,ja	1954
UTSCB	34--1	27	30	dosh	contrl sagbrush,seeded ran	frischknecht,nc;/	1973

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NAWTA	29---	404	417	many	summer range relatns, utah	julander,o; jeffe	1964
VEZOA	7---6	10	14	many	changes in landscap, fauna	golov,ba	1973

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CFGGA	5----	1	71	wldl	crop damage by wldl, calif	biehn,er	1951
ECMOA	24--2	349	376	wldl	ecol suc, aband farml, man	beckwith,sl	1954
JFUSA	60--1	45	46	vert	econ losses caused by vert	howard,we	1962
JWMAA	2---3	79	81	wldl	use of salt, control distr	case,gw	1938
JWMAA	3---1	1	13	wldl	electric fence in managemt	mcatee,wl	1939
JWMAA	23--2	240	241	wldl	damage to crops, unit stat	mcdowell,rd; pill	1959
NAWTA	10---	219	224	biga	livestock on western range	schwan,he	1945
NAWTA	12---	165	174	game	contest,w publ game fields	wagar,jvk	1947
NAWTA	15---	83	93	biga	importn, stckman, lnd mgmt	stoddart,la	1950

OTHER PUBLICATIONS

Rouse, C. H. 1962. Antelope and sheep fences. Interstate Antelope Conf. Trans. December: 45-47.

Sunderstrom, C. 1966. Fence designs for livestock and big game. Intermountain Forest and Range Exp. Sta. Range Improvement Notes 11(2): 3-11.

U. S. Bureau of Land Management. 1965. Position statement on woven wire fencing on the public lands in Wyoming. Bureau Land Mangt., Cheyenne, Wyo. 23 p.

CHAPTER 21, WORKSHEET 4.1a

Agricultural damage by wild ruminants

Damage to agricultural crops by wild ruminants can be substantial. Review the material on ecological metabolism in PART III, Chapter 7, TOPIC 6 to determine the energy required during the part of the year when crops are vulnerable. Usea simple average or a weighted mean metabolic structure (See PART VI, CHAPTER 18, TOPIC 2) to arrive at a "metabolic cost per animal per day." Then answer the following questions.

ELWK?

MBLM?

ELMD?

Number of animals?

Number of days on this agricultural diet?

Fraction of the animal's diet?

Gross energy in the agricultural diet?

Digestibility of the agricultural diet?

Metabolizable energy in the agricultural diet?

Amount of agricultural diet required to meet this energy requirement per day?

Multiply the answer above by the fraction of the animal's diet.

Multiply by the number of days on this agricultural diet.

Multiply by the number of animals on this diet.

The final product above is a direct estimate of the amount of the agricultural diet consumed.

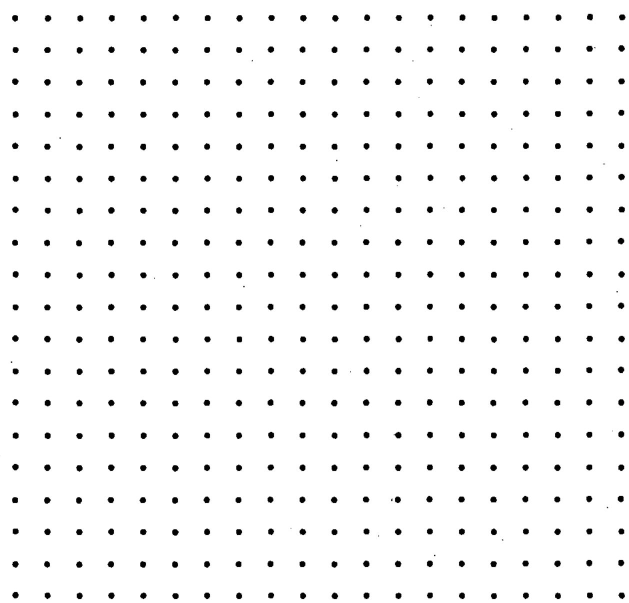
Consider the additional effects of waste, trampling, etc.

Consider the additional effects of foraging on plant productivity.

CHAPTER 21, WORKSHEET 4.1b

The cost of fencing to protect agricultural crops

Fencing may be used to protect high-density agricultural crops such as gardens and orchards. Determine the perimeters of different sizes of fields of different shapes which you may illustrate below. Then determine the costs of fencing in relation to crop production and value.



One acre = 43560 square feet

One acre = 208.7*2 feet

One rod = 16.5 feet

One chain = 66 feet = 20 m

One hectare = 1000 square meters

Choose the scale you wish to use and complete the calculations below.

Dimensions	Area	Perimeter
_____x_____	_____	______
_____x_____	_____	______
_____x_____	_____	______

Answer the following questions to determine the cost.

Perimeter?

Number of corners?

Distance between parts?

Number of parts?

Extra parts for corners?

Cost of parts?

Length of fence?

Cost of fence?

Expected labor costs?

Total cost of fence?

Life expectancy of fence?

Cost per year?

Maintenance cost per year?

Gross value of agricultural crops protected?

Net profit from agricultural crops protected?

Profit margin as percent of gross?

Fence cost as per cent of gross?

Is fencing a good investment?

Is production possible without protection?

Management alternatives?

UNIT 4.2: FORESTRY

The effect of deer and elk on forest reproduction may be much greater than supposed because the injury or removal of young seedlings is not conspicuous. Murie (1951) pointed out over 30 years ago the potential for elk to suppress reproduction until the older trees are gone and there is no young growth to replace them. The eventual removal of forest shrubs effects the cover and landscape for years to come.

An early survey of deer damage to forest reproduction in Wisconsin showed that up to 80% of hard maple reproduction and 33% of white pine reproduction were lost to deer damage. Further, one-half of the conifers were damaged to varying degrees (Ruhl 1956). On the west coast, the most desirable timber trees were also found to be the most palatable to deer (Cowan 1956), and they also concentrated on the burn areas where reforestation is most desirable and necessary.

LITERATURE CITED

Cowan, I. M. 1956. Life and times of the coast black-tailed deer. Pages 523-617 In The Deer of Norrth America, W. P. Taylor, Ed. The Stackpole Compny, Harrisburg, Pa. 668 p.

Murie, O. J. 1951. The Elk of North America. The Stackpole Company, Harrisburg, Pa. 376 p.

Ruhl, H. D. 1956. Hunting the white-tail. Pages 261-331. In The Deer of North America, W. P. Taylor, Ed. The Stackpole Company, Harrisburg, Pa. 668 p.

REFERENCES, UNIT 4.2

FORESTRY

BOOKS

TYPE	PUBL	CITY	PGES	ANIM	KEY WORDS-----------------	AUTHORS/EDITORS--	YEAR
aubo	acbo	wadc	178	----	clearcuttng, view from top	horwitz,ej	1974

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
FOSCA	1---1	61	67	od--	eff brows, qual hardw timb	switzenberg,df; /	1955
JRMGA	19...	212	214	od--	doca,brush man infl prefer	powell,j; box,tw	1966
JWMAA	16--3	390	391	od--	repellent sprays, foliage	howard,we; hjersm	1952
JWMAA	30--1	109	114	od--	eval mamm repell, brws, nd	dietz,dr; tigner,	1968
JWMAA	33--4	922	926	od--	contrl use,forest, elec fn	tierson,wc	1969
NAWTA	14---	232	238	od--	advances, forest, game mgt	warren,c	1949
NFGJA	11--2	115	118	od--	use of commercial clear-ct	krull,jn	1964
PSAFA	1948-	257	263	od--	forest grazin, eastern for	branble,wc; engli	1948
PSAFA	1957-	101	104	od--	mismanag, threat sust yiel	bennett,al	1957
PSAFA	1957-	137	140	od--	effects, pulpwood cutting	gill,j	1958
PSAFA	1958-	127	129	od--	conflict, integ, man fores	adams,l	1958
TIMBA	56...	48	51	od--	increasing problem, damage	anonymous	1955
VJSCA	10--4	262	262	od--	eff for prac, man, abun, d	quillen,jh,jr	1959
XAFNA	109--	1	33	od--	forestry, pine reg, n jers	little,s; moorhe/	1958
XANEA	33---	1	37	od--	browsing hardwoods,nrth es	shafer,el,jr	1965
XFWWA	1955-	1	13	od--	rabbit, repellents, protec	besser,j	1955
XPNWA	5----	1	8	od--	repell reduce brow, ponder	driscoll,rs	1963

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
BICOB	6---1	69	70	odvi	morganza floodway opening	yancey,rk	1974
JFUSA	29--5	700	708	odvi	damage to n england forest	hosley,nw; crow,/	1931
JFUSA	34--5	472	474	odvi	for mgt, deer req, alleghe	ehrhart,eo	1936
JFUSA	47-11	909	913	odvi	eff on conifer repro, mont	adams,l	1949
JFUSA	54--4	238	242	odvi	manag, deer, ponderosa pin	neils,g; adams,l/	1956
JFUSA	56--2	116	121	odvi	eff stand dens, brow, repr	curtis,ro; rushmo	1958
JFUSA	58--5	385	387	odvi	slash protect seedl, brows	grisez,tj	1960
JFUSA	61-10	741	746	odvi	compar timbr, wildl values	gamble,hb; bartoo	1963
JFUSA	64-12	801	805	odvi	brws infl,loggd n hrdw for	tierson,wc; patr/	1966
JFUSA	68--5	298	300	odvi	brwsng, hrdwd regen, appal	harlow,rf; downin	1970

odvi continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JFUSA	68-11	692	694	odvi	deer habtat mgt,eastrn for	jordan,js	1970
JFUSA	68-11	695	700	odvi	deer densty contrl,for mgt	behrend,df; matt/	1970
JFUSA	68-11	701	704	odvi	improv hab,cut conif swmps	krefting,lw; phil	1970
JFUSA	71-12	752	757	odvi	manag hab, loblol-shrtleaf	halls,lk	1973
JWMAA	4---1	77	79	odvi	simple repellent, conif pl	weiss,s	1940
JWMAA	17--4	487	494	odvi	eff sim damag, conif, hare	krefting,lw; stoe	1953
JWMAA	21--1	75	80	odvi	eff brow, repro, hardw-hem	stoeckeler,hj; s/	1957
JWMAA	23--4	450	451	odvi	prevent browsng, pine plnt	mcneel,w,jr; kenn	1959
NAWTA	20---	539	551	odvi	manag, deer, ponderosa pin	neils,g; adams,l/	1956
NYCOA	10--1	30	31	odvi	the forest and the game	hall,ag; weight,f	1955
PMACA	19---	....	....	odvi	deer yards, uppr pen, mich	wakeman,mc	1933
PSAFA	1947-	210	214	odvi	cedar swamp managmnt, mich	bartlett,ih	1948
PSAFA	1948-	257	263	odvi	e forest grazi prblm, penn	bramble,wc; engli	1949
PSAFA	1957-	101	104	odvi	mismng, sustaind yield, pa	bennett,al	1958
PSAFA	1965-	229	233	odvi	mng, sustaind yield, brows	shaw,sp; ripley,t	1966
PVPCB	7....	229	234	odvi	bird, mamm probs, se pine	campbell,te	1976
TNWSD	27---	1	18	odvi	deer dens contr, adirondac	behrend,df; matt/	1970
WSCBA	12-10	3	23	odvi	damage, forest reprod surv	deboer,sg	1947
XANEA	308--	1	8	odvi	impact on hardwood regener	marquis,da	1974
XARRA	89---	1	51	odvi	brows, ponderosa pine plan	adams,l	1951
XARRA	105--	1	3	odvi	brows, natural conifer see	adams,l	1951

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
FOSCA	22--2	106	121	odhe	genetic resistan, doug fir	dimock,ej,II, si/	1976
JFUSA	61--1	53	54	odhe	repellnts effctv, pine, sw	heidmann,lj	1963
JFUSA	61-10	734	740	odhe	odvi, timbrlnds, n rockies	pengelly,wl	1963
JFUSA	64--5	322	326	odhe	eff sim dee bros, doug-fir	crouch,gl	1966
JFUSA	72--5	282	285	odhe	eff logging, fora val, col	regelin,wl; wall/	1974
JRMGA	30--5	352	356	odhe	doca, forage selec compari	currie,po; reich/	1977
JWMAA	36--4	1025	1033	odhe	forag use, relativ to logg	wallmo,oc; regel/	1972
JWMAA	41--3	543	559	odhe	ceel,use nat,mod piny pine	short,hl; evans,/	1977

odhe continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NAWTA	30---	310	321	odhe	reseeded forest,meadow, az	hungerford,cr	1965
NOSCA	52--3	233	235	odhe	deer & forest reprod, wash	amaral,m	1978
XARRA	141--	1	4	odhe	response, altern-strip cle	wallmo,oc	1969

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JFUSA	51--9	620	623	ceel	od, the tree farm program	hagenstein,wd	1953
JFUSA	72-12	764	766	ceel	odhe, odvi, patch cut pine	patton,dr	1974
NOSCA	46--1	59	66	ceel	od, veg, soils in exclosur	tiedemann,ar; ber	1972
SFORA	22--1	14	17	ceel	maurading deer, scotland	grant,pch	1968
SFORA	26--1	37	42	ceel	management, economic, dile	viscount of arbut	1972
SISRB	15...	1	54	ceel	damage to scots pine from	lavsund,s	1974
TDSKA	78--2	239	250	ceel	dosh, forestation, norway	bortnes,g	1970
TTFPB	13---	39	64	ceel	eff fire, vert herb, scott	miller,gr; watson	1973
XFIPA	129--	1	15	ceel	aspen mortality, wint rang	krebill,rg	1972
ZEJAA	23--4	214	218	ceel	bark damage, red timb valu	anonymous	1977

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

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

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
				oram			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
ECMOA	14--3	255	270	doca	10 yr stud grz, ungrz wood	dambach,ca	1944

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
JFUSA	53--6	436	438	many	lessons, europ, fores mngm	johnson,fw; adams	1955
JSWCA	27--6	250	254	many	clrcttng, beneficial aspct	resler,ra	1972
VEZOA	7---6	10	14	many	chan landsc, fauna, poltav	golov,ba	1973

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
JFUSA	34--2	98	103	wldl	correlatn forstry & wldl m	gabrielson,in	1936
JFUSA	47--9	698	699	wldl	foresters as wldl managers	gabrielson,in	1949
JFUSA	51--6	440	443	wldl	modif for prac, hab better	swift,e	1953
JFUSA	60--1	13	15	wldl	industrial forestry, south	kitchens,jh,jr	1962
JFUSA	60--1	15	17	wldl	indus forstry, lake states	hurd,es	1962
JFUSA	60--1	18	20	wldl	indust forestry, northeast	bennett,al	1962
JFUSA	65-11	807	813	----	forest cover and logging	young,ja; hedric/	1967
JFUSA	68--5	270	273	wldl	forest wildlife responsibi	shaw,sp	1970
JSWCA	27--6	255	258	wldl	clearcttng, detrim aspects	pengelly,wl	1972
JWMAA	21--1	101	103	wldl	interpret overbrowsing, no	webb,wl	1957
JWMAA	35--4	644	657	wldl	manag criter, oaks, wildli	goodrum,pd; reid/	1971
JWMAA	39--3	557	562	wldl	brows, herbage, intens man	wolters,gl; schmi	1975
NAWTA	27---	368	376	wldl	recent forest manag trends	gould,wp	1962
NAWTA	27---	402	412	----	tim-wildl coor con, eas fo	giles,rh,jr	1962
NYCOA	7---6	8	8	wldl	chemi-peeling and wildlife	cook,db	1953
PSAFA	1947-	200	205	game	controlled burning, michig	smith,nf	1948
PSAFA	1954-	138	141	wldl	wisc coop forest wildl pro	bulfer,de	1954
PSAFA	1962-	167	171	wldl	wldlf-fores mgt, wldl resp	mcginnes,bs; ripl	1962
TTFPB	5----	177	194	wldl	disc of wl man, fire, land	komarek,r	1966
XFNNA	33---	1	3	wldl	atlantic white cedar, jers	little,s; somes,h	1965
XFPNA	6----	1	28	mamm	protecting for trees, seed	radwan,m	1963
XGNFA	14---	1	13	wldl	timber cut, sust yield, wo	roach,ba	1974

CHAPTER 21, WORKSHEET 4.2a

The cost of protecting reforested lands from damage by wild ruminants

The WORKSHEET after the previous UNIT includes questions on costs of protecting agricultural crops. Review those questions. Then describe the protection needed for reforested stands, choose the methods to be used to protect the stands, and set up a WORKSHEET of your own in the space below.

CLOSING COMMENTS

This CHAPTER has focused on the habitat. Additional information and lists of SERIAL references are found in PART IV, CHAPTER 13: PRIMARY PRODUCTION AND FORAGE FOR WILD RUMINANTS. The effects of man's activities, both intentional and unintentional, direct and indirect, on the habitat has a marked impact on wildlife populations. The next CHAPTER includes discussions and references on BIOLOGICALLY-BASED SPECIES MANAGEMENT.

Aaron N. Moen
March 20, 1982

GLOSSARY OF SYMBOLS - CHAPTER TWENTY-ONE

bMTR = b value for the mortality rate

bPOP = b value for the population

bRPR = b value for the reproductive rate

MTRT = mortality rate

NAIP = number of animals in the initial population

PRDN = predicted N; predicted number of animals in the population

RPRT = reproductive rate

YAPN = years ahead to predict the population

GLOSSARY OF SERIAL CODENS - CHAPTER TWENTY-ONE

Serials are identified by five-character, generally mnemonic codes called CODEN, listed in 1980 BIOSIS, LIST OF SERIALS (BioSciences Information Service, 2100 Arch Street, Philadelphia, PA 19103).

The headings for the lists of SERIALS are:

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

The volume and issue numbers (VO-NU) are given after the CODEN entry, followed by beginning page (BEPA), ending page (ENPA), species discussed (ANIM)1, KEY WORDS from the title, AUTHORS [truncated if necessary, slash (/) indicates additional authors], and YEAR.

ABSZA	Annales Botanici Societatis Zoologicae Botanicae Fennicae Vanamo
AGJOA	Agronomy Journal
ALCNA	Alabama Conservation
AMFGA	American Fruit Grower
AMFOA	American Forests
AMNAA	American Midland Naturalist (US)
ANKIA	Animal Kingdon, New York Zoological Society Bulletin
ATRLA	Acta Theriologica (Poland)
AZWBA	Arizona Game and Fish Department Wildlife Bulletin (US)
BICOB	Biological Conservation
BNMFD	New Mexico Department of Game & Fish Bulletin
BOREA	Botanical Review (US)
BPURD	Biological Papers of the University of Alaska Special Report
BRYOA	Bryologist (US)
BSETB	Botanical Society of Edinburgh Transactions (Scotland)
BYMOA	Byulletin Moskovskago Obschestva Ispyrtatalei Prirody Otdel Biologicheskii (USSR)
BZOBA	Bonner Zoologische Beitraege
CAFGA	California Fish and Game (US)
CAFNA	Canadian Field Naturalist (Canada)
CAGRA	California Agriculture
CBTIA	Contributions from the Boyce Thompson Institute
CFGGA	California Department of Fish and Game, Game Bulletin
CGFPA	Colorado Division of Game, Fish, and Parks Special Report (US)
CNBUA	Connecticut Storrs Agricultural Experiment Station Bulletin
CNJMA	Canadian Journal of Comparative Medicine and Veterinary Science
CNSVA	Conservationist
CPLSA	Canadian Journal of Plant Science (Canada)
CWRSB	Canadian Wildlife Service Report and Management Bulletin Series
CZOOA	Carnets de Zoologie

ECMOA Ecological Monographs
ECOLA Ecology
EVCNA Environmental Conservation
EXJOA Explorer's Journal

FHSCA Farm and Home Science
FNQBA Faune du Quebec
FOSCA Forest Science (US)
FRCRA Forestry Chronicle (Canada)
FUNAA Fauna (Oslo)

ICNSA Iowa Conservationist
IGWBA Idaho Department of Fish and Game Wildlife Bulletin
IUCSB International Union for Conservation of Nature and Natural Resources Publications New Series

JAGRA Journal of Agricultural Research (Washington, DC)
JAPEA Journal of Applied Ecology (England)
JBRGA Journal of the British Grassland Society (England)
JFUSA Journal of Forestry (US)
JOMAA Journal of Mammalogy
JRMGA Journal of Range Management
JSWCA Journal of Soil and Water Conservation
JTBIA Journal of Theoretical Biology
JWMAA Journal of Wildlife Management

LESOA Lesovedenie (USSR)

MDCBA Minnesota Department of Conservation Technical Bulletin
MDCRA Michigan Department of Conservation Game Division Report
MFNOA Minnesota Forestry Notes
MOCOA Missouri Conservationist
MRLTA Murrelet, The
MRYCA Maryland Conservationist
MUZPA Miscellaneous Publications, Museum of Zoology, University of Michigan

NAWLA National Wildlife
NAWTA North American Wildlife and Natural Resources Conference, Transactions of the (US)
NCANA Naturaliste Canadien, Le
NEJZA Netherlands Journal of Zoology (Netherlands)
NFGJA New York Fish and Game Journal (US)
NMWIA New Mexico Wildlife
NOSCA Northwest Science (US)
NPKMA National Parks Magazine

NPSMD United States National Park Service Scientific Monograph Series
NYCOA New York Conservationist
NZFTA New Zealand Forest Service, Forest Research Institute Technical Paper
NZJFA New Zealand Journal of Forestry
NZSRA New Zealand Science Review
NZTBA New Zealand Journal of Science and Technology Section B

OCRNA Ocrotirtea Naturii
OFWRA Ontario Fish and Wildlife Review (Canada)
ORYXA Oryx

PASCC Proceedings of the Alaskan Scientific Conference (US)
PCGFA Proceedings of the Southeastern Association of Game and Fish Commissioners (US)
PIAIA Proceedings of the Iowa Academy of Science (US)
PMACA Papers of the Michigan Academy of Sciences, Arts and Letters
POASA Proceedings of the Oklahoma Academy of Science
PORSA Proceedings of the Oregon Academy of Science
PSAFA Proceedings of the Society of American Foresters (US)
PVPCB Proceedings of the Vertebrate Pest Conference
PZESA Proceedings of the New Zealand Ecological Society

QBMAA Michigan Agricultural Experiment Station, Quarterly Bulletin

RRFBA Report Reelfoot Lake Biological Station of the Tennessee Academy of Science
RWLBA Roosevelt Wildlife Bulletin

SALKA Science in Alaska Proceedings Alaskan Science Conference
SCBUB Sierra Club Bulletin
SCIEA Science
SFORA Scottish Forestry
SISRB Institutionen for Skogskzoologi Rapporter och Uppsatser
SRBSB Supplemento alle Richerche di Biologie della Selvaggina
SWNAA Southwestern Naturalist (US)

TAGPA Texas Agricultural Progress
TCNSA Transactions of the Cardiff Naturalist's Society
tdbca Transactions of the Desert Bighorn Council
TDSKA Tidsskrift for Skogbruk
TIMBA Timberman
TISAA Transactions of the Illinois State Academy of Science (US)
TNWSD Transactions of the Northeast Section, The Wildlife Society (US)
TRVIA Terre Vie (La Terre et la Vie)
TTFPB Tall Timbers Fire Ecology Conference, Proceedings (US)

UABPA Biological Papers of the University of Alaska
UAECA Utah Agricultural Experiment Station Circular
UASPA Proceedings of the Utah Academy of Sciences, Arts and Letters
UCPZA University of California Publications in Zoology
UTSCB Utah Science (US)

VEZOA Vestnik Zoologii
VILTA Viltrevy (Sweden)
VIWIA Virginia Wildlife
VJSCA Virginia Journal of Science
VMUBA Vestnik Moskovskogo Universiteta Seriya VI Biologiya Pochvovedenie

WCDBA Wisconsin Conservation Department Technical Bulletin
WGFBA Wyoming Game and Fish Commission Bulletin
WLMOA Wildlife Monogrphhs (US)
WLSBA Wildlife Society Bulletin
WMBAA Wildlife Management Bulletin (Ottawa) Series 1 (Canada)
WSCBA Wisconsin Conservation Bulletin

XAFNA Northeastern Forest Experiment Station, Station Paper
XAMPA U S D A Miscellaneous Publication
XANEA U S Forest Service Research Paper NE (US)
XARRA U S Forest Service Research Note RM (US)
XASRA U S Forest Service Research Note SE (US)
XATBA U S D A Technical Bulletin
XDAFA U S D A Farmer's Bulletin
XFIPA U S Forest Service Research Paper INT (US)
XFNCA U S Forest Service Research Paper NC (US)
XFNNA U S Forest Service Research Note NE (US)
XFRMA U S Forest Service Research Paper RM (US)
XFWLA U S D I Fish and Wildlife Service, Wildlife Leaflet
XFWWA U S Fish and Wildlife Service Special Scientific Report - Wildlife
XGNFA U S Forest Service General Technical Report NE (US)
XNFSA U S National Park Service Fauna of the National Parks of the United States, Fauna Series
XPNWA U S Forest Service Research Note PNW (US)

ZEJAA Zeitschrift fuer Jagdwissenschaft
ZORVA Zoologisk Revy (Sweden)

The headings for the lists of BOOKS are:

TYPE PUBL CITY PAGE ANIM KEY WORDS------------------ AUTHORS/EDITORS-- YEAR

All essential information for finding each book in the library is given on just one line. The TYPE of book could have either AUTHORS (aubo) or EDITORS (edbo). Publishers (PUBL) and CITY of publication are given with four-letter mnemonic symbols defined below. The PAGE column gives the number of pages in the book; ANIM refers to the species discussed in the book (given as a four-letter abbreviation of genus and species), and KEY WORDS listed are from the title. The AUTHORS/EDITORS and YEAR of publication are given in the last two columns.

aakn	Alfred A. Knopf	New York, NY	nyny
acbo	Acropolis Books, Ltd.	Washington, DC	wadc
acpr	Academic Press	New York, NY	nyny
cite	Cambridge Institute of Terrestrial Ecology	Cambridge, England	caen
cnpc	C. C. Nelson Pub. Co.	Appleton, WI	apwi
cscs	Charles Scribner's Sons	New York, NY	nyny
dnhp	Doubleday/Natural History Press	New York, NY	nyny
fost	Forest and Stream Publishing Co.	New York, NY	nyny
gbri	Gillespie Brothers, Inc.	Stamford, CT	stct
jwis	John Wiley and Sons, Inc.	New York, NY	nyny
macm	MacMillan Co.	New York, NY	nyny
mfgd	Montana Fish and Game Department	Helena, MT	hemt
mhbc	McGraw-Hill Book Company, Inc.	New York, NY	nyny
monp	The Monumental Press	Baltimore, MD	bama
naus	National Audubon Society	New York, NY	nyny
nhfg	New Hampshire Fish and Game Dept.	Concord, NH	conh
nmgf	New Mexico Game and Fish Dept.	Santa Fe, NM	sfnm
oxup	Oxford University Press	London, England	loen

pnfr	U. S. Pacific Northwest Forest and Range Experiment Station	Portland, OR	poor
qupr	Queen's Printer	Ottawa, Ontario	oton
ropr	Ronald Press	New York, NY	nyny
stac	The Stackpole Company	Harrisburg, PA	hapa
ucap	University of California Press	Berkeley, CA	beca
unbp	University of Nebraska Press	Lincoln, NE	line
uopr	University of Oklahoma Press	Norman, OK	nook
utop	University of Toronto Press	Toronto, ON	toon
uwyp	University of Wyoming Press	Laramie, WY	lawy
vipr	Viking Press	New York, NY	nyny
wiin	Wiley-Interscience	New York, NY	nyny
wimi	Wildlife Management Institute	Washington, DC	wadc
winp	Winchester Press	New York, NY	nyny
wiso	The Wildlife Society	Washington, DC	wadc
yaup	Yale University Press	New Haven, CT	nhct

GLOSSARY OF ANIMAL CODE NAMES

Wild ruminants are referred to in this CHAPTER by a 4-character abbreviation from the family, genus and genus-species. These are listed below under Abbreviation.

Scientific names of North American wild ruminants are those used in BIG GAME OF NORTH AMERICA, edited by J.C. Schmidt and D. L. Gilbert (1979: Stackpole Books, Harrisburg, PA 17105, 494 p.), and may be different from the scientific names given in the original literature.

The abbreviations used for North American wild ruminants are listed below.

CLASS: MAMMALIA

ORDER: ARTIODACTYLA	Abbreviation
FAMILY: CERVIDAE	cerv
GENUS: *Odocoileus* (deer)	od--
SPECIES: *O. virginianus* (white-tailed deer)	odvi
O. hemionus (mule deer)	odhe
GENUS: *Cervus* (Wapiti, elk)	ce--
SPECIES: *C. elaphus*	ceel
GENUS: *Alces* (moose)	
SPECIES: *A. alces*	alal
GENUS: *Rangifer* (caribou)	
SPECIES: *R. tarandus*	rata
FAMILY: ANTILOCAPRIDAE	
GENUS: *Antilocapra*	
SPECIES: *A. americana* (pronghorn)	anam
FAMILY: BOVIDAE	bovi
GENUS: *Bison* (bison)	bi--
SPECIES: *B. bison*	bibi
GENUS: *Ovis* (sheep)	ov--
SPECIES: *O. canadensis* (bighorn sheep)	ovca
O. dalli (Dall's sheep)	ovda
GENUS: *Ovibos*	
SPECIES: *O. moschatus* (muskox)	obmo
GENUS: *Oreamnos*	
SPECIES: *O. americanus* (mountain goat)	oram

The abbreviations used for European wild ruminants are listed below.

CLASS: MAMMALIA

ORDER: ARTIODACTYLA	Abbreviation
FAMILY: CERVIDAE	cerv
GENUS: Capreolus (roe deer)	ca--
SPECIES: C. capreolus	caca
GENUS: Dama (fallow deer)	da--
SPECIES: D. dama	dada
GENUS: Cervus (Wapiti, elk)	ce--
SPECIES: C. elaphus (red deer)	ceel
GENUS: Alces (moose)	
SPECIES: A. alces	alal
GENUS: Rangifer (caribou)	
SPECIES: R. tarandus	rata
FAMILY: BOVIDAE	
GENUS: Bison (bison)	
SPECIES: B. bonasus	bibo
GENUS: Capra (ibex, wild goat)	cp--
SPECIES: C. aegargrus(Persian ibex)	cpae
C. siberica (Siberian ibex)	cpsi

OTHERS

Abbreviations for a few other species and groups of species may appear in the reference lists. These are listed below.

Axis axis (axis deer)	axax
Elaphurus davidianus (Pere David's deer)	elda
Cervus nippon (Sika deer)	ceni
Hydropotes inermis (Chinese water deer)	hyin
Muntiacus reevesi (Chinese muntjac)	mure
Moschus moschifer (Chinese musk deer)	momo
Ammotragus lervia (Barbary sheep)	amle
Ovis nivicola (snow sheep)	ovni
Ovis musimon (moufflon)	ovmu
Ovis linnaeus (Iranian sheep)	ovli
Rupicapra rupicapra (chamois)	ruru
big game	biga
domestic sheep	dosh
domestic cattle	doca
domestic goat	dogo
domestic ruminant	doru
mammals	mamm
three or more species of wild ruminants	many
ruminants	rumi
ungulates	ungu
vertebrates	vert
wildlife	wldl
wild ruminant	wiru

JULIAN DAY: MONTH AND DAY EQUIVALENTS*

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Day
1	001	032	060	091	121	152	182	213	244	274	305	335	1
2	002	033	061	092	122	153	183	214	245	275	306	336	2
3	003	034	062	093	123	154	184	215	246	276	307	337	3
4	004	035	063	094	124	155	185	216	247	277	308	338	4
5	005	036	064	095	125	156	186	217	248	278	309	339	5
6	006	037	065	096	126	157	187	218	249	279	310	340	6
7	007	038	066	097	127	158	188	219	250	280	311	341	7
8	008	039	067	098	128	159	189	220	251	281	312	342	8
9	009	040	068	099	129	160	190	221	252	282	313	343	9
10	010	041	069	100	130	161	191	222	253	283	314	344	10
11	011	042	070	101	131	162	192	223	254	284	315	345	11
12	012	043	071	102	132	163	193	224	255	285	316	346	12
13	013	044	072	103	133	164	194	225	256	286	317	347	13
14	014	045	073	104	134	165	195	226	257	287	318	348	14
15	015	046	074	105	135	166	196	227	258	288	319	349	15
16	016	047	075	106	136	167	197	228	259	289	320	350	16
17	017	048	076	107	137	168	198	229	260	290	321	351	17
18	018	049	077	108	138	169	199	230	261	291	322	352	18
19	019	050	078	109	139	170	200	231	262	292	323	353	19
20	020	051	079	110	140	171	201	232	263	293	324	354	20
21	021	052	080	111	141	172	202	233	264	294	325	355	21
22	022	053	081	112	142	173	203	234	265	295	326	356	22
23	023	054	082	113	143	174	204	235	266	296	327	357	23
24	024	055	083	114	144	175	205	236	267	297	328	358	24
25	025	056	084	115	145	176	206	237	268	298	329	359	25
26	026	057	085	116	146	177	207	238	269	299	330	360	26
27	027	058	086	117	147	178	208	239	270	300	331	361	27
28	028	059	087	118	148	179	209	240	271	301	332	362	28
29	029	[060]	088	119	149	180	210	241	272	302	333	363	29
30	030		089	120	150	181	211	242	273	303	334	364	30
31	031		090		151		212	243		304		365	31

* For leap year, February 29 = JDAY 60. Add 1 to all subsequent JDAYs.

LIST OF WORKSHEETS - CHAPTER TWENTY-ONE

THE BIOLOGY AND MANAGEMENT OF WILD RUMINANTS

CHAPTER TWENTY-TWO

BIOLOGICALLY-BASED SPECIES MANAGEMENT

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

First printing, March 1982

Library of Congress Catalog Number 80-70984

CONTENTS OF CHAPTER TWENTY-TWO

BIOLOGICALLY-BASED SPECIES MANAGEMENT

CHAPTER 22. BIOLOGICALLY-BASED SPECIES MANAGEMENT

The earth has a finite supply of space and food resources that never runs out? Of course not. Space is rather fixed; there are only so many acres of land on which to live. Food is a renewable resource, but a variable in time as food resources change with the seasons, and animal requirements change too. Thus, one must look at resources and requirements, both changing, in order to understand ecology of any species, including wild ruminants.

Before the settlement of North America, wild ruminant populations were affected by predation, weather, snow accumulations, fires set by lightning, blow-downs, decadent forest stands, beaver meadows, etc., plus hunting by native tribes. Some Indian tribes carried on agriculture to a considerable extent, while others depended almost entirely on hunting and fishing. Some tribes managed deer range by fire, bu carefully protecting their territory from hunting by others, by prohibiting hunting at certain seasons, and, in at least one instance, appear to have had a buck law (Silver 1957).

The native human population was sparsely distributed. Hunting pressure was nothing like it is now, nor were hunters equipped with the superior weapons of today.

Predators had a much more important role in population dynamics, and they were much more widely distributed in presettlement times than now. Panthers, more common in the west, were also found along the Atlantic coast. Wolves were likely the most important of all predators. They were much feared by the Europeans, and were nearly exterminated. They were a menace to the livestock of the settlers, and competed with the settlers for wild game.

The numbers of large predators such as panthers and wolves have been decreasing every since colonial days, and today relatively few remain in the United States.

The history of wild ruminant populations varies in different parts of the country. There was a span of as much as 200-250 years between dates of settlement in various regions. Roads, boats, and then the railroads affected the rates of settlement, and hence the use of the land. In New Hampshire, for example, early settlers arrived in the interior around the beginning of the 18th century with their belongings on their backs. They did not intend to establish farming communities, but to get rich from the fur trade and precious metals. This materialized, and subsistance farming sprung up out of necessisity. Clearing the forests was difficult, however, and very few settlers were able to comply with the provision of their grants that one or two acres be cleared annually by every claimant. Furthermore, until the close of the French and Indian wars in 1760, they were so busy fighting with Indians and with each other over conflicting boundaries (both the Colonies of Massachusetts and New Hampshire having granted the same land to different parties, for example) that they had little time for agriculture. They lived largely from hunting like the Indians before them, and deer became scarce from overhunting. There were no restrictions on the manner and season of taking; it was a matter of survival, and the scarcer game became, the harder it was hunter (Silver 1957). Meanwhile progress in agriculture was slow, and deer were all but wiped out by the mid-1800's (Silver 1968).

Minnesota, not permanently settled until the mid-1800's, had three distinct vegetation zones. The evergreen forest, with pines, white spruce, balsam, and white birch on the uplands and black spruce, tamarack, and white cedar in the swamps, originally covered the northeast third of the state. The deciduous forest with oaks, maples, and ash, covered a diagonal strip across the state from the southeast to northwest, forming a transition zone between the evergreen forest and the prairies. The tall-grass prairie covered the southern and western one-third of the state. Pioneers were involved in lumbering and farming, with agriculture increasing and lumbering decreasing by the early 1900's.

The evergreen forests were habitat for woodland caribou prior to the peak of lumbering about 1900. After these forests were cut and burned, white-tailed deer moved in from the south and west, encouraged by the growth of shrubs and small trees that followed lumbering operations. Meanwhile, deer, elk, bird, and bison were exterminated from the agricultural regions due to hunting and the shift to agriculture.

Interior New York State, the hunting ground of the Iroquois, was first occupied by white man about the middle of the 18th century--not far from the same time many of the central towns in New Hampshire were settled. Here, however, lumbering rivaled the fur trade from the start. In 1850, New York produced one-fifth of all the lumber cut in the whole country. At that time, the central Adirondacks was one of the major deer concentrations in the northeast. Darwin (1874) quotes an article in the December 1869 issue of "The American Naturalist" in which the writer, who has hunted for 21 years ". . . in the Adirondacks where the Cervus virginianus abounds." According to dates given, the writer heard of "spikehorn bucks" about 1855, and describes them quite thoroughly. Darwin concluded that the first spikehorn was a freak of nature, but it provided its possessor with such a competitive advantage that its offspring rapidly gained on common bucks and were expected to "entirely supercede them in the Adirondacks."

The conclusions are amusing, both for the quickness of Darwin to use the appearance of spikehorns as evidence of natural selection, and the ignorance of nutrition which, due to high deer populations in the mid-1800's, was inadequate.

Present knowledge and understanding permits rational biologically-based management programs. Different types of seasons permit a greater or lesser degree of control over sex and age ratios as well as over the total number of deer. Without the large predators, some form of hunting is essential to prevent overpopulation of most wild ruminants. Regulations vary between species, between states, and often within states by districts or management areas. Techniques such as selective cutting, strip cutting, and clearings furnish forage adjacent to winter cover. Costs may be kept to a minimum by completing cutting regimes that are both good forestry and beneficial to wildlife.

This CHAPTER 22 includes descriptions of the concept of sustained yield (TOPIC 1), use of harvest reports (TOPIC 2), specific population manipulation (TOPIC 3), and case studies of different species (TOPIC 4).

LITERATURE CITED

Darwin, C. 1874. The Descent of Man and Selection in Relation to Sex. Rand, McNally & Company, New York. 672 p.

Silver, H. 1957. A History of New Hampshire Game and Furbearers. Survey Report No. 6, New Hampshire Fish and Game Dept., Concord. 466 p.

Silver, H. 1968. In The White-tailed Deer of New Hampshire, H. R. Siegler, Ed. Survey Report No. 10, New Hampshire Fish and Game Dept., Concord. 256 p.

REFERENCES, CHAPTER 22

EXAMPLES OF BIOLOGICALLY-BASED SPECIES MANAGEMENT

BOOKS

TYPE	PUBL	CITY	PGES	ANIM	KEY WORDS-----------------	AUTHORS/EDITORS--	YEAR
edbo	blsp	oxen	....	----	scientif mgt for conservat	duffey,e; watts,a	1971
aubo	rokp	loen	597	cerv	deer,great britain, irelnd	whitehead,gk	1964
aubo	fost	nyny	426	cerv	antelope, deer, north amer	caton,jd	1877
edbo	stac	hapa	668	od--	deer of north america	taylor,wp	1956
aubo	stac	hapa	128	od--	if deer are to survive	dasmann,w	1971
aubo	vipr	nyny	194	od--	deer of the world	whitehead,gk	1972
aubo	omcc	eail	107	odvi	the white-tailed deer	madson,j	1961
edbo	nhfg	conh	256	odvi	the white-tai deer, new ha	siegler,hr	1968
aubo	ucap	beca	567	odhe	a herd of mule deer	linsdale,jm; tomi	1953
edbo	stac	hapa	....	odhe	pp.449-482, management of	hunter,gn; yeager	1956
edbo	unbp	line	605	odhe	mule, black-tailed, no ame	wallmo,oc	1981
aubo	oxup	loen	215	ceel	herd, red dee, stud, behav	darling,ff	1937
aubo	stac	hapa	386	ceel	elk of north america	murie,oj	1959
aubo	wiwe	eail	125	ceel	the elk	madson,j	1966
aubo	ucap	beca	209	ceel	tule elk	mccullough,dr	1971
edbo	codw	deco	84	ceel	western states elk wrkshop	denny,rn	1977
aubo	cite	oxen	74	ceel	ecology of red deer	mitchell,b; stai/	1977
aubo	uwyp	lawy	294	ceel	n amer elk: ecol,behav,mgt	boyce,ms; hayden-	1979
edbo	wimi	wadc	....	ceel	ecology,mngmnt, n amer elk	thomas,jw; towei	in pr
aubo	utop	toon	280	alal	north american moose	peterson,rl	1955
aubo	stac	hapa	238	anam	prnghrn antlp & its mngmnt	einarsen,as	1948
aubo	stac	hapa	225	anam	hunting pronghorn antelope	popowski,b	1959
aubo	macm	nyny	300	rata	bar-gr car of north canada	pike,w	1892
aubo	ukap	laka	163	rata	bar-ground carib, keewatin	harper,f	1955
aubo	qupr	oton	339	rata	migratory, barren-ground c	kelsall,jp	1968
aubo	rowa	loen	....	bovi	wild oxen, sheep, goats of	lydekker,r	1898
aubo	nyzs	nyny	254	bibi	amer bisn; extermi, restor	garretson,ms	1938
aubo	blhp	....	15	bibi	the unvanquished buffalo	collins,hh,jr	1952
aubo	utop	toon	991	bibi	n amer buffalo, wild state	roe,fg	1970
aubo	thcr	nyny	242	bibi	the buffalo	haines,f	1970
aubo	aakn	nyny	339	bibi	the time of the buffalo	mchugh,t	1972
aubo	swap	atoh	374	bibi	the buffalo book, saga ani	dary,d	1974
aubo	ucap	beca	316	bibi	n amer bison, evol, classi	mcdonald,jn	1981

aubo	uopr	nook	247	ov--	the great ark of the wild	clark,jl	1964
edbo	winp	nyny	....	ov--	wild sheep of modrn n amer	trefethen,jb	1975
aubo	usgp	wadc	242	ovca	the bighorn of death valle	welles,re; welle	1961
aubo	uchp	chil	383	ovca	mount sheep: behavr, evolu	geist,v	1971
aubo	coup	itny	248	ovca	mt sheep, man, norther wil	geist,v	1975
aubo	qupr	oton	166	obmo	muskoxen,biol,taxon,canada	tener,js	1965
aubo	haho	nyny	85	obmo	oomingmak, expedi, nunivak	matthiessen,p	1967
aubo	doup	nyny	318	many	americ anim; popular guide	stone,w; cram,we	1902
aubo	cscs	nyny	347	many	our big game	huntington,d	1904
aubo	cscs	nyny	1267	many	life hist northern animals	seton,et	1909
aubo	ropr	nyny	129	many	wildlife in alaska, ecolog	leopold,as; darli	1953
edbo	holt	nyny	264	many	records of n a big game an	boone & crockett	1958
aubo	ropr	nyny	547	many	mammals of north america	hall,er; kelson,k	1959
aubo	ucap	beca	586	many	wildlife of mexico	leopold,as	1959
aubo	vipr	nyny	304	many	wildlife in america	matthiessen,p	1959
aubo	repu	nyny	335	many	principals of mammalogy	davis,de; golley,	1963
aubo	blsp	loen	308	many	guide, study of productivi	golley,fb; buechn	1968
aubo	jhpr	bamd	769	many	mammals of the world	walker,ep; paradi	1968
aubo	whfr	sfca	458	many	wildlife ecology	moen,an	1973
aubo	utop	toon	438	many	the mammals of canada	banfield, awf	1974
edbo	iucn	mosw	940	many	behavr & its relatn to mgt	geist,v; walther,	1974
edbo	stac	hapa	494	many	big game, n amer, ecol,mgt	schmidt,jl; gilbe	1978
aubo	dalt	laen	271	dada	fal de: histor, distr, bio	chapman,d; chapma	1975
aubo	repu	nyny	1023	dome	bioenergetics and growth	brody,s	1945
edbo	coup	itny	1463	dome	duke's physiol domest anim	swenson,mj	1970
aubo	acpr	nyny	202	ungu	reproductive behav, ungula	fraser,af	1968
aubo	dodo	nyny	1220	game	v 3, lives of game animals	seton,et	1929
aubo	cscs	nyny	481	game	game management	leopold,a	1933
aubo	mhbc	nyny	479	wldl	wildlife management	trippensee,re	1948
aubo	macm	nyny	274	wldl	pp.122-39, wildlife manage	gabrielson,in	1951
edbo	scru	nyny	174	biga	records of n amer big game	boone & crockett	1952
aubo	macm	nyny	250	wldl	wildlife conservation	gabrielson,in	1959
aubo	dche	boma	120	wldl	wlidlife mgmnt & conservat	trefethen,jb	1964
aubo	codw	deco	209	biga	1976 colorado biga harvest	denny,rn	1977

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
MDCBA	5----	1	64	odvi	w-tailed deer of minnesota	erickson,ab; gunv	1961
MDCRA	14---	1	80	odvi	michigan white-tailed deer	jenkins,dh; bartl	1959
RWLBA	6---2	153	325	odvi	w-t deer of the adirondcks	townsend,mt; smit	933
RWLBA	6---2	327	385	odvi	wntr, spr obsrv, adirndcks	spiker,cj	1933
WCDBA	14---	1	282	odvi	white-tailed deer, wiscons	dahlberg,bl; guet	1956

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
AZWBA	3----	1	109	odhe	in arizona chaparral	swank,wg	1958
CAFGA	26--2	139	166	odhe	calif deer, rcky mt mule d	mclean,dd	1940
CFGGA	8----	1	163	odhe	life hist, managemt, calif	taber,rd; dasmann	1958
CGFPA	4----	1	39	odhe	lit review, mvmnts & captr	siglin,rj	1965
CGFPA	7----	1	26	odhe	literature review on behav	dorrance,mj	1967
JOMAA	37--2	143	164	odhe	behavior, populatn ecology	dasmann,rf; taber	1956

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
UCPZA	88---	1	209	ceel	tule elk: hist, behav, eco	mccullough,dr	1969
WLMOA	16---	1	49	ceel	status, ecol, roosevel elk	harper,ja; harn/	1967
WLMOA	24---	1	66	ceel	the sun river elk herd	knight,rr	1970

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
AMNAA	52--2	392	399	alal	observ in yellowstone park	mcmillan,jf	1954
BEHAA	20--3	377	416	alal	behavi in british columbia	geist,v	1963
FUNAA	8....	40	43	alal	moose habits and habitat	rush,wm	1946
JOMAA	39--1	128	139	alal	summr obsrvtns, behv,ontar	de vos,a	1958
MUZPA	25---	1	44	alal	the moose of isle royale	murie,a	1934

alal continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NCANA	101--	1	436	alal	ecol, proc inter sym, pt 1	bedard,j	1974
NCANA	101--	437	735	alal	ecol, proc inter sym, pt 2	bedard,j	1974
VLUBB	22-15	74	82	alal	[elk behav, leningr, russ]	timofeeva,ek	1967
ZOOLA	41-14	105	118	alal	ecol behav popula dynamics	denniston,rh	1956

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
BPURD	2----	1	215	rata	ecol, caribou, prudhoe bay	white,rg; thomso/	1975
CWRSB	38---	1	71	rata	biology, kaminuriak popula	dauphine,tc,jr	1976
UABPA	3----	1	44	rata	behav of barren-ground car	pruitt,wo	1960
UABPA	8----	1	82	rata	ecology, managment, sweden	skunke,f	1969
WMBAA	10A--	1	79	rata	prelim investigation, pt 1	banfield,awf	1954
WMBAA	10B--	1	112	rata	prelim investigation, pt 2	banfield,awf	1954
WMBAA	12---	1	148	rata	caribou, continued studies	kelsall,jp	1957
WMBAA	15---	1	145	rata	barrn gr carib, coop study	kelsall,jp	1960

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
AMNAA	43--2	257	354	anam	life hist,ecol,rng use,tex	buechner,hk	1947
CAFGA	30--4	221	241	anam	prong-hornd antlp in calif	mclean,dd	1944
CGFPA	3----	1	28	anam	litera revi on prong behav	prenzlow,ej	1965
CGFPA	17---	1	16	anam	some behav patterns of the	prenzlow,ej; gil/	1968
JOMAA	3----	82	105	anam	the prong-horn	skinner,mp	1922

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NPSMD	161--	1	161	bibi	bison, yellowston nat park	meagher,mm	1973

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
AMNAA	24--3	505	580	ov--	distribut, variat, no amer	cowan,imct	1940
AZWBA	1----	1	153	ov--	desert bighorn	russo,jp	1956
WLMOA	4----	1	174	ov--	united sta, past to future	buechner,hk	1960

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
AMNAA	56--2	297	324	ovca	ecology of mountain sheep	mccann,lj	1956
CAFNA	77--2	77	94	ovca	behavior of a bighorn herd	blood,da	1963
CJZOA	46--5	899	904	ovca	ovda,delay soc, phys matur	geist,v	1968
IGWBA	1----	1	154	ovca	stat, life hist, mgt, idah	smith,dr	1954
JOMAA	18--2	205	212	ovca	prelim study, yllwstn n pk	mills,hb	1937
JOMAA	20--4	440	455	ovca	bighorn sheep of texas	davis,wb; taylor,	1939
JOMAA	24--1	1	11	ovca	notes on life histor, colo	spencer,cc	1943
SCBUB	35--6	29	76	ovca	survey, sierra nevada bigh	jones,fl	1950
WGFBA	1----	1	127	ovca	wyoming bighorn study	honess,rf; frost,	1942
WLMOA	4----	1	174	ovca	bighorn sheep in the u s	buechner,hk	1960
XNFSA	6----	1	242	ovca	bighorn of death valley	welles,re; welles	1961

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
XNFSA	5----	1	238	ovda	the wolves of mt mckinley	murie,a	1944

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
WMBAA	9----	1	34	obmo	prelim stud,ellesmr is,nwt	tener,js	1954

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CAFNA	81--1	1	22	oram	obsrvtns,kootenay nt pk,bc	holroyd,jc	1967
CGFPA	8----	1	23	oram	literature review, ecology	hibbs,ld	1966
IGWBA	2----	1	142	oram	life history, mgtmt, idaho	brandborg,sm	1955

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
MRLTA	41--3	34	40	dogo	feral goats, british colum	geist,v	1960

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
PZSLA	142-1	129	163	dosh	study, feral pop, st kilda	boyd,m; doney,jm/	1964

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JTBIA	2---1	63	68	----	environments of anim, plan	browning,to	1962
QRBIA	22---	283	314	----	life tabls, natrl pop anim	deevey,es	1947

OTHER PUBLICATIONS

Proceedings of the White-tailed Deer in the Southern Forest Habitat Symposium (First meeting in 1962)

Transactions of the Annual Meeting of the Northeast Deer Study Group (Annual meeting beginning 1964)

Proceedings of the North American Moose Conference (Fifth conference in 1968)

Proceedings of the International Reindeer/Caribou Symposium (First meeting in 1977, second in 1980)

Proceedings of the Biennial Antelope States Workshop

Transactions of the Interstate Antelope Conference

Transactions of the North American Wild Sheep Conference (Second meeting in 1976)

Transactions of the Desert Bighorn Council (Annual meeting beginning 1957)

Proceedings of the International Mountain Goat Symposium

Proceedings of the Annual Conference of Western Association of State Game & Fish Commissioners (Annual conference beginning 1921)

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

OTHER PUBLICATIONS

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.

TOPIC 2. HARVEST REPORTS

Harvest reports are about the only means of determining the main cause of mortality--hunting--in wild ruminant populations. They are gathered by two ways: total reporting and sampling. Required reports are being used more now than in previous years, and one reason for that is the use of computers in keeping records. Voluntary reports result in only a sample of the total since all hunters do not voluntarily send reports in. Other means of sampling may also be used, and subsamples may be identified by information requested in the license application.

The two ways to derive the data: Total reporting and sampling, are discussed in UNITS 1.1 and 1.2 respectively.

Collecting the data is one thing, analyzing it and presenting summaries is a necessary follow-up. The importance of making summaries available lto the public is emphasized , and this is now possible if a good electronic system of filing the data is set up. Harvest summaries are discussed in UNIT 2.3.

UNIT 2.1: TOTAL HARVEST REPORTS

Total harvest reports are expected when the law requires that each animal killed be brought to a checking station where it is recorded and tagged. Data on sex, age, dressed weights, and other biological characteristics may also be recorded when it is checked.

Records of hunting licenses sold may be easily kept in computer files and licenses sold compared to licenses of hunters checking animals in. Comparisons of the characteristics of all hunters compared to successful hunters may then be made and insights gained into reasons and characteristics of hunter success. The number of comparisons that could be made by computer analyses far exceeds the amount of information that can be reasonably called for on an application, and legally called lfor in view of the rights of individuals to privacy.

Total harvest reports are increasing in use, and the biological data that comes from total harvest reports has the potential for becoming extremely valuable if the animals are evaluated accurately. This is a concern, because there are known examples of inaccurate aging of white-tailed deer, for example, due to lack of accurage and standardized methods and training procedures.

REFERENCES, UNIT 2.1

TOTAL HARVEST REPORTS

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CAFGA	25--2	96	165	od--	kill recrds, mgt of huntng	johnson,fw	1939

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	16--1	58	63	odvi	bag checks, suprior natl f	stenlund,mh; mor/	1952
JWMAA	33--4	871	880	odvi	harv est, samp vs complete	hawn,lj; ryel,la	1969
JWMAA	44--1	245	249	odvi	sex, age bias in hunt kill	coe,rj; downing,/	1980
MOCOA	14--3	1,	12	odvi	dixie's dope on decem deer	robb,d	1953
PCGFA	20---	181	188	odvi	calibrat hunt effor & succ	weber,af; barick/	1966
TNWSD	11---	1	5	odvi	check stat data, size herd	stevens,cl	1953

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	25--4	415	421	ceel	diff harv in 2 herds, mont	picton,hd	1961
NAWTA	26---	468	480	ceel	eval elk validations, colo	denney,rn	1961

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CWOPA	15---	1	19	rata	distr carib harv, nc canad	parker,gr	1972

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
				oram			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	17--3	256	267	biga	game check stations, color	rogers,ge	1953
NAWTA	11---	373	382	----	meth determ huntr num, act	wandell,wn	1946

UNIT 2.2: SAMPLING FOR HARVEST REPORTS

Sampling for harvest reports is a necessity when funds and personnel are limited so total harvest reports are not possible. Considering the average cost of a license to limit big game and the scope of the programs of state correction agencies, it is surprising that any state has the funds to do anything more than sampling for harvest reports. Computer-assisted record-keeping is fast and efficient, but trained personnel are needed in several steps.

Sampling regimes include voluntary reporting, which it is known results in a biased sample, and some kind of statistical sampling technique which, it is hoped, reduces bias to a tolerable minimum. Subcouples may also be taken, grouping hunters into zip code areas (useful for urban:rural comparisons), counties, areas hunted, etc.

REFERENCES, UNIT 2.2

SAMPLING FOR HARVEST REPORTS

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
CAFGA	25--2	96	165	od--	kill recrds, mgt of huntng	johnson,fw	1939
JWMAA	11--1	103	104	od--	probble errors, sampl meas	cronmiller,fp	1947

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
JWMAA	16--1	58	63	odvi	bag checks,suprior nat for	stenlund,mh; mor/	1952
JWMAA	33--4	871	....	odvi	harv est, samp vs complete	hawn,lj; ryel,la	1969
JWMAA	44--1	245	249	odvi	sex, age bias in hunt kill	coe,rj; downing,/	1980
MOCOA	14--3	1,	12	odvi	dixie's dope on decem deer	robb,d	1953
PCGFA	20---	181	188	odvi	calibrat hunt effor & succ	weber,af; barick/	1966

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	25--4	415	421	ceel	diff harv in 2 herds, mont	picton,hd	1961
NAWTA	26---	468	480	ceel	eval elk validations, colo	denney,rn	1961

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CWOPA	15---	1	19	rata	distr carib harv, nc canad	parker,gr	1972

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
				oram			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	17--3	256	267	biga	func, oper check sta, colo	roger,ge	1953
NAWTA	11---	373	381	----	meth determ huntr num, act	wandell,w	1946

UNIT 2.3: HARVEST SUMMARIES

Harvest summaries involved long and tedious hours of "hard work under the goose-neck lamp" a few years ago. Today, the work involved in preparing harvest summaries comes in two phases. The first phase involves setting up the data collection format. This must be done properly for electronic storage and computer analysis, making rapid data processing possible. The data-processing itself takes very little computer time. The second phase involves evaluations and presentation of the results. This requires the human mind for subjective interpretations of similarities and differences, and time to write the explanations out, edit them, and print them for distribution.

The preparation of written summaries is a much more efficient process now than it was a few years ago as electronic word processing makes rapid editing and printing possible. In fact, the electronic processing of both numbers and words is collectively called "information processing."

It is important to get information out on the results of hunting seasons as soon as possible. It is theoretically possible to have information out before the hunting season is even over, and this could be useful in redistributing hunters, increasing or decreasing the take in local areas, etc. If check-station data are reported daily and the inputs evaluated electronically in relation to license sales, population distributions, travel conditions, and other human characteristics, daily bulletins could be issued. This is similar to the election return profiles that are generated while voting is still in progress. It is possible, but how appropriate it is may be another good question.

Making the daily harvest summaries available to the public may take too much of the unknown out of the hunt. Perhaps subject evaluations of hunting success each evening, even if they are wrong or based on very inadequate information, are more appropriate, lest the hunters become nothing more than checkers to be moved according to circumstances.

The dawn of the electronic age is both exciting and frightening.

REFERENCES, UNIT 2.3

HARVEST SUMMARIES

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	15--1	27	32	cerv	deer kill, diff systm hunt	westerskov,k	1951

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
AMNTA	2---9	466	476	od--	deer & deer hunting in tex	wright,c	1868
CAFGA	39--4	507	515	od--	reprt on january seas, cal	laughlin,j	1953
JWMAA	29--1	59	71	od--	control huntng, sq mi encl	vanetten,rc; /	1965
NMWIA	13--5	16	17	od--	deer harvest, 1967, n mexi	snyder,w	1968

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CNSVA	23--6	13	14	odvi	the deer take in 1968-1969	jackson,l; miller	1969
ICNSA	13--1	1,	5	odvi	the 1953 iowa deer season	madson,j	1954
ICNSA	17--4	25,	29	odvi	harvst 2813 dee, 1957,iowa	speaker,eb; kline	1958
JWMAA	5---3	333	336	odvi	trends, kill, bucks, wisco	schunke,wh; bussi	1941
JWMAA	16--2	121	131	odvi	hunt stati, ran cond, minn	gunvalson,ve; er/	1952
JWMAA	19--3	346	352	odvi	results of controlld hunts	krefting,lw; eri/	1955
JWMAA	20--3	297	302	odvi	results special hunt, minn	krefting,lw; eric	1956
JWMAA	22--2	141	148	odvi	nmbrs, kill, recreatnl use	burcalow,dw; mars	1958
JWMAA	24--3	342	344	odvi	hunt seas waste, fox trail	schofield,rd	1960
JWMAA	29--1	59	73	odvi	contrlld hunt in enclosure	van etten,rc; sw/	1965
JWMAA	33--4	791	795	odvi	controlld hunt, wildl refg	roseberry,jl; au/	1969
JWMAA	40--3	500	506	odvi	spat dist hntrs; inf forst	thomas,tw; gill,/	1976
MRYCA	32--4	17	17	odvi	harvest increase, maryland	anonymous	1955
MRYCA	40--1	14	15	odvi	1962 deer season, maryland	kerns, c	1963
MRYCA	44--2	14	16	odvi	1966 deer report, maryland	halla,b	1967
NAWTA	4----	449	553	odvi	harvst in natl forst, stud	sanders,rd	1939
NAWTA	13---	459	464	odvi	bow'n'arrw huntng, conserv	haugen,ao	1948
NAWTA	13---	492	508	odvi	harvest of deer, wisconsin	cramer,ht	1948
NAWTA	29---	454	463	odvi	reln hunter access to kill	james,ga; johnso/	1964

odvi continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NFGJA	10--2	186	193	odvi	eff archry in contrl abund	severinghaus,cw	1963
NFGJA	16--1	1	18	odvi	1967 seas, moose rivr area	dickinson,nr; sev	1969
NFGJA	22--2	128	147	odvi	anal 1st harv, cary estate	davis,ja	1975
NOSCA	47--4	250	255	odvi	hunting success, idaho dee	will,gc	1973
NYCOA	3---4	24	25	odvi	deer kill, season of 1948	holweg,aw	1949
NYCOA	6---4	33	33	odvi	the 1951 deer take, n york	ny conservat dept	1952
NYCOA	9---5	34	35	odvi	the 1954 deer kill in n.y.	bromley,aw	1955
NYCOA	10--1	19	23	odvi	deer hunting - then & now	darrow,rw	1955
PCGFA	19---	141	146	odvi	eff opening date, harvest,	murphy,da	1965
PCGFA	27---	114	119	odvi	mgt implic heav hunt press	cook,rl	1974
PIAIA	61---	615	630	odvi	reslts of iowa's deer seas	sanderson,gc; spe	1954
TNWSD	9----	1	12	odvi	anal kill-curv, female dee	gill,j	1953
TNWSD	33---	19	33	odvi	odhe, unretrvd deer, liter	losch,ta; samuel,	1976
VIWIA	8....	10	13	odvi	knowldg gaind, managd hunt	engle,jw; hanlon,	1952
VIWIA	14--3	18	19	odvi	1952 big levels refug hunt	mosby,hs	1952
VIWIA	14-10	18	....	odvi	highlights of va 1952 stud	richards,ev	1953
VIWIA	31--7	22	22	odvi	n w virginia 1969 harvest	thornton,je	1970
WLSBA	7---1	10	16	odvi	hunter-inflicted wounding	stormer,fa; kirk/	1979
WSCBA	3--10	40	46	odvi	wiscons deer situatn, 1938	scott,we	1938
WSCBA	11--8	6	15	odvi	the 1945 deer kill, wiscon	bersing,os	1946
WSCBA	12--1	5	11	odvi	huntng records 1930-46, wi	buss,io; buss,he	1947
WSCBA	12--9	4	12	odvi	the 1946 deer huntn season	bersing,os	1947
WSCBA	13--4	7	16	odvi	bow & arrow hunting, wisco	bersing,os	1948
WSCBA	13-10	11	12	odvi	1947 deer season, wisconsi	bersing,os	1948
WSCBA	15--1	7	8	odvi	prelim report on 1949 seas	dahlberg,bl; hale	1950
WSCBA	15--4	3	7	odvi	wisc deer prob, 1949 seasn	dahlberg,bl	1950
WSCBA	16--1	10	12	odvi	prelim report on 1950 seas	kabat,c; hale,jb	1951
WSCBA	17--5	22	23	odvi	1951 harvest high; 129,475	wisc conserv dept	1952
WSCBA	21-12	3	9	odvi	new deal for deer & hunter	keener,jm	1956
WSCBA	22--2	8	11	odvi	the 1956 deer season, wisc	keener,jm	1957

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CAFGA	20--1	79	80	odhe	deer tag returns, in 1933	walner,ol	1934
CAFGA	29--4	180	190	odhe	deer refuge under buck law	cronemiller,fp	1943
CAFGA	38--2	235	238	odhe	reslts special hunt, refug	bryan,hf; long,wi	1952
DRCWD	2....	1	179	odhe	anam, accss priv land, hun	rounds,rc	1975

odhe continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JOMAA	35--3	457	458	odhe	additional recrds for minn	erickson,ab; bue,	1954
NAWTA	13---	451	457	odhe	crippling losses, utah	costley,rj	1948
XFWLA	295--	1	8	odhe	mortality, gunshot wounds	robinette,wl	1947

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	25--4	415	421	ceel	differntl huntr harv, mont	picton,hd	1961
NMWIA	13--3	4	....	ceel	elk hunts, 1967, new mexic	turner,f	1968
PMACA	51--1	187	191	ceel	reslts,1st contr hunt,mich	moran,rj	1966

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NAWTA	24---	422	447	alal	harvests, newfnd & scandin	pimlott,dh	1959

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CWOPA	15---	1	19	rata	distr carib harv, nc canad	parker,gr	1972

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
DRCWD	2....	1	179	anam	odhe, accss priv land, hun	rounds,rc	1975
NAWTA	4----	216	220	anam	oregon's open season, 1938	einarsen,as	1939
NMWIA	15--1	9	11	anam	antelop huntng, 1969, n mx	snyder,w	1970

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
tdbca	2----	1	5	ovca	huntng desert bighrn,nevad	jonez,a	1958
tdbca	2----	6	12	ovca	evaluation huntng, arizona	russo,jp	1958
tdbca	3----	20	23	ovca	1958 hunt highlghts, nevad	jonez,a	1959
tdbca	3----	24	28	ovca	1958 hunt highlights, ariz	kelly,w	1959
tdbca	4----	76	80	ovca	1959 huntng results, nevad	jonez,a	1960
tdbca	4----	81	84	ovca	highlights 1959 hunt, ariz	reed,jj	1960
tdbca	5----	80	83	ovca	hunting seasons in mexico	cardenas,jad	1961
tdbca	5----	84	86	ovca	hunt highlights, arizona	reed,jj	1961
tdbca	5----	87	89	ovca	1960 huntng results,nevada	jonex,a	1961
tdbca	6----	114	116	ovca	1961 desrt bghrn hunt,ariz	jantzen,ra	1962
tdbca	6----	119	123	ovca	progress report 1961	jonez,a	1962
tdbca	7----	12	16	ovca	progrss,hunt report,nevada	brechbill,r	1963
tdbca	7----	151	155	ovca	progrs rpt, kofa game rang	duncan,ge	1963
tdbca	7----	169	174	ovca	progress report, arizona	jantzen,ra	1963
tdbca	7----	175	177	ovca	progress reprt, new mexico	freeman,pe	1963
tdbca	8----	127	132	ovca	1963 progr, hunt rept, nev	jonez,a	1964
tdbca	9----	84	88	ovca	1964-65 progress, hunt,nev	brechbill,ra	1965
tdbca	11---	1	5	ovca	1965, 1966-67 seasn, nevad	barngrover,lw	1967
tdbca	11---	86	93	ovca	15 years hunting, arizona	russo,jp	1967
tdbca	12---	1	4	ovca	results, 1967 hunt, utah	john,rt	1968
tdbca	12---	7	11	ovca	huntng progress rpt, nevad	barngrover,lw	1968
tdbca	13---	71	75	ovca	hunt reslts 1968-69, nevad	barngrover,lw	1969

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
CNSVA	22--6	12	13	biga	1967 harvest sets records	hesselton,wt	1968
NAWTA	14---	410	423	----	huntng stats, 1936 vs 1946	ludy,d	1949

OTHER PUBLICATIONS

Coleman, H. S. 1947. Administration and results of bisexual antelope hunt in Nevada. Proc. West. Assoc. State Fish and Game Comm. 27: 107-109.

TOPIC 3. SPECIFIC POPULATION MANIPULATIONS

Specific population manipulations may be made by regulating the length of the season, time of the season, shooting hours, bag limit, sex selection, number of licenses sold, and other factors affecting the hunting pressure. Such manipulations are used when populations are high enough to allow regulated hunting.

A different kind of population manipulation occurs when populations do not exist in areas of suitable habitat due to previous extirpation. Bighorn sheep, for example, have not been able to fill suitable habitats, so trapping and transplanting have been done. The new populations are then protected from hunting until established well enough to produce an animal surplus.

Manipulations of established populations by sex selection are discussed in UNIT 1.1 and introductions in UNIT 1.2.

Trophy hunting has been a successful population management practice under certain conditions, especially after the reintroduction and establishment of a population in suitable habitat, but before the population is large enough to warrant a more general season. This is discussed further in UNIT 3.3.

There are many cases of successful management that could be discussed in UNIT 3.4. The recovery of bison and pronghorn populations are two examples. The sustained yields of deer herds in many of the states and provinces are other examples. Successful management practices are emphasized here. Those resulting in problems are discussed in the next CHAPTER.

UNIT 3.1: SEX SELECTION

Game conservation began with attempts to restrict the kill after populations had been exploited beyond what they could endure. Later it was realized that populations must be kept within the carrying capacity of the range. Vrious methods have been tried which are designed to increase or hold populations in control. The simplest kind of season is the "either-sex season." This permits the taking of game of either sex and any age. Such regulations result in a more or less even sex ratio in the population.

The buck law, permitting harvest of antlered males only, is an effective way to increase populations, protecting the reproducing members, females, of a population.

A buck law is most successful when authority for control of hunting seasons and detailed knowledge of herd composition and range conditions are available. When there is any indication that the number is too high, the conservation department must have the right to alter the season in order to keep numbers within the carrying capacity of the range. There is no time to wait for the slow processes of public education and/or legislative action.

Controversies over "either-sex" and "antleress seasons" have been many. The antlerless season is not, strictly speaking, a buck law since it also prohibits taking of male fawns which at shooting range cannot be told from females during their first hunting season. A buck law results in an increase in the number of deer. The main difficulty is in getting rid of it once the need to increase the herd has passed and reinstating it if necessary.

Beyond the basis sex selection in seasons held in different given states, various restrictions and privileges may be included. Bag limits, post-season hunts for antlerless deer in buck law states, party permits that allow groups of hunters to harvest females in addition to the legal males, no hunting on Sunday, hunting with dogs permitted, etc., can all be built into a management program.

Season lengths and dates vary, sometimes within regions of the same state. Season length has some effect on the kill, but it is well documented that a season that is twice as long does not result in twice the kill. Hunters are most effective in the first day or two, and then more often during a short season. The time of the season has a large effect on the kill because it often determines the likelihood of snow on the ground. The number of weekends and holidays included in the season have an effect on the number of hunters in the field.

Since habitat conditions are seldom uniform throughout an entire state, most states have two or more natural zones adapted to different management programs. These natural divisions hsould, but do not always coincide with areas designated by legislative decision for certain types of management.

New Hampshire, for example, is naturally divided into two zones by the White Mountains which run horizontally across almost the entire width of the state. The climate and forest are quite dissimilar between the two natural zones.

Minnesota has three major vegetation zones, including the northern coniferous forest in the northeast, the prairie in the southwest, and the mixed hardwood forest between the two which occurs as a belt from the southeastern to the northwestern corners. Current deer management zones are based on these vegetation zones, with further considerations of population densities, intensity of agriculture, topography and cover, etc.

REFERENCES, UNIT 3.1

SEX SELECTION

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CAFGA	29--4	180	190	od--	deer refuge under buck law	cronemiller,fp	1943
CAFGA	44--3	231	251	od--	calif first either-sx seas	dasmann,wp; hjer/	1958
JFUSA	70--4	200	203	od--	ecological framework, mgmt	....	1972
JWMAA	2---1	1	2	od--	preventng deer concntratns	cox,wt	1938
JWMAA	19--1	143	147	od--	theoret frmwrk, mgt problm	thomas,dw; pasto,	1955
JWMAA	31--4	667	679	od--	dynmic prgrmmng, mgt plnng	davis,ls	1967
NYCOA	29--4	18	20	od--	advances, science deer mgt	....	1975
XFSWA	57---	1	16	od--	control of irruptions, nev	aldous,cm	1948

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
ALCNA	26--3	14	16	odvi	sportsman; save that deer	haugen,ao	1954
ALCNA	27--3	12	13	odvi	why shoot spikes	lueth,fx	1955
ALCNA	28--5	14	16	odvi	antlers away!	haugen,ao	1957
JFUSA	68-11	695	700	odvi	density control, forst mgt	behrend,df; matt/	1970
JWMAA	9---1	76	78	odvi	weathr and the kill, maine	fobes,cb	1945
JWMAA	33--4	791	795	odvi	controlled hunt, wldl refu	roseberry,jl; au/	1969
JWMAA	35--1	71	75	odvi	hunting stag caribou, newf	bergerud,at	1971
JWMAA	38--3	499	507	odvi	diff vuln dur control harv	roseberry,jl; kli	1974
NAWTA	16---	472	491	odvi	lack buck law harmed herd?	siegler,hr	1951
NFGJA	10--2	186	193	odvi	effect archry control abun	severinghaus,cw	1963
TNWSD	21---	1	4	odvi	performnc party permit, nj	mangold,re	1964
WSCBA	8---8	11	19	odvi	wisc deer today & tomorrow	feeney,ws	1943
WSCBA	9---6	3	4	odvi	what's next in deer policy	leopold,a	1944
WSCBA	9--11	10	....	odvi	six points of deer policy	wisconsin conserv	1944
WSCBA	13-12	22	22	odvi	too many deer, pennsylvani	anonymous	1948
WSCBA	14-11	6	9	odvi	critic rev wisc deer probl	dahlberg,bl; guet	1949
WSCBA	17--1	3	9	odvi	herd contr methods, result	swift,e	1952
WSCBA	17--9	26	27	odvi	kil to drop under buck law	wisc conserv dept	1952
WSCBA	21-12	10	13	odvi	states favor eithr-sx hunt	bunn,l	1956
XFNCA	39---	23	27	odvi	harv reg, pop contr, mid-w	jenkins,dh	1970

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
AMFOA	53--9	392	394	ceel	the firing line, mass hunt	murie,oj	1947
SFORA	21--1	15	18	ceel	mangmnt, control, scotland	macnally,l	1967

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	32--4	722	728	alal	harv reduct, popul in newf	bergerud,at; man/	1968

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CWOPA	15---	5	20	rata	distr of harv in nc canada	parker,gr	1972

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
TRVIA	1961-	266	285	anam	reg nmbrs,relat to lnd 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
tdbca	2----	13	16	ovca	sheep huntng in new mexico	ogren,ha	1958
tdbca	13---	6	13	ovca	factrs affctng,desert,utah	irvine,ca	1969

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	36--1	128	134	biga	periodic harv, increas yld	wlaters,cj; bandy	1972
NAWTA	22---	544	569	biga	effct hunting, control pop	longhurst,wm	1957
NWGRA	30--3	13	16	biga	a fair policy on big game	shantz,hl	1940
PCGFA	24	46	50	biga	mgt implicatns,disease,tex	marburger,rg; ro/	1970
WUARA	442--	48	51	game	mgt,what's new, farm scien		1938
XIBPA	2---1	79	80	ungu	dynamic programmng, mngmnt	peden,dg; rice,rw	1972

OTHER PUBLICATIONS

Bandy, P. J. 1970. The paradox of the bighorn sheep. Trans Northern Wild Sheep Council p. 1-4.

Morgan, J. K. 1970. An analysis of the effects of ten years' open season hunting on bighorn sheep populations in Idaho. Trans. Northern Wild Sheep Council. 34 p.

Rutherford, W. H. 1970. Bighorn sheep - what is optimum harvest? Trans. Northern Wild Sheep Council pp. 50-53.

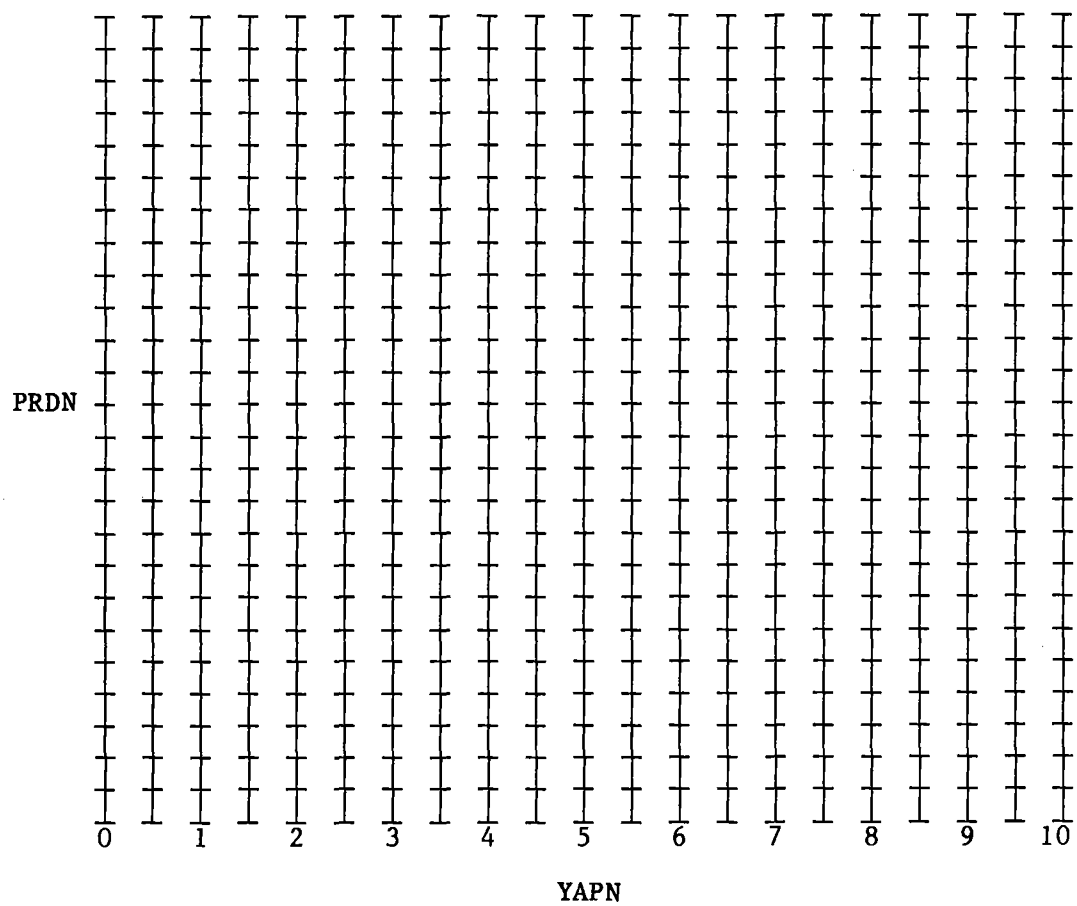
Wishart, W. 1970. When and why it is good management to shoot bighorn ewes and lambs. Trans. Northern Wild Sheep Council pp. 56-60.

____________. 1966. A differential hunter harvest of pronghorn antelope in Montana. Proc. West. Assoc. State Fish and Game Comm. 46: 116-122.

CHAPTER 22, WORK SHEET 3.1a

Population predictions in relation to sex selection

Using the arithmetic procedures for predicting populations (PART VI, CHAPTER 19, UNIT 4.1) predict population changes as a result of sex selection by hunters. Use selection ratios ranging from 50:50 for an either sex season with no selection pressure to a males only season. Plot the growth rates of the populations in the grid below.



UNIT 3.2: TRAPPING, REMOVAL, AND INTRODUCTIONS

Trapping and transplanting of bighorn sheep has been a common mangement practice in the states from North Dakota westward. Several different methods of capture have been used, including padded steel traps, foot snares, canal traps, and tranquilizing darts. Traps are baited with water, salt, hay, grain, or anything that might attract the target animals. Susceptibility to trapping depends on range conditions; water is a better bait during a prolonged dry period than during a rainy spell.

Captured animals are usually marked in some way and transported, often by air, to new habitats for reintroduction. Marking techniques include such things as ear tags, streamers, horn and hide bands, collars, bells, and spray painting.

Reintroductions are not the simple, successful management techniques we would like them to be. The animals are placed in an alien habitat, resulting in psychological trauma even if their physical needs are all met. Animls to be released are often held in an enclosure for a while before release; this is an approach being evaluated for the reintroduction of woodland caribou in northeastern Minnesota.

Sheep and goats have often been exchanged by western states. Sheep have been trapped in Colorado in exchange for mountin goats from Montana, for example.

REFERENCES, UNIT 3.2

TRAPPING, REMOVAL, AND INTRODUCTIONS

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
JWMAA	3---4	288	294	od--	trapping penned deer	ruff,fj	1939
JWMAA	32--1	187	190	od--	a drop-net deer trap	ramsey,cw	1968
NAWTA	4----	231	235	od--	probl, trappng, remov, uta	dixon,js; sumner,	1939

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
JWMAA	19--4	501	502	odvi	an efficient handlng crate	mikula,ej	1955
JWMAA	26--1	79	85	odvi	dsprsl,releasd dee,indiana	hamilton,r	1962
MRLTA	31--3	43	44	odvi	introduced in se washingtn	swanson,cv	1950

odvi continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NAWTA	9----	162	167	odvi	arkansas' transplntng prog	wood,r	1944
NAWTA	17---	472	476	odvi	extirpatn, restor, n carol	jenkins,jh	1952
PCGFA	5----	....	....	odvi	deer restoration in se u s	barick,fb	1951
PCGFA	6----	....	....	odvi	trapping, restock in arkan	hunter,c	1952

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JAZAA	5---1	43	44	odhe	transplanted odhe in arizo	mcculloch,cy	1968
JWMAA	7---4	407	411	odhe	mass trapping of mule deer	thomas,gm; allred	1943

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NAWTA	15---	597	611	ceel	re-estab seas migr,transpl	allred,wj	1950
NFGJA	23--1	98	99	ceel	failure to survive, adiron	severinghaus,cw;/	1976
NPKMA	41---	16	16	ceel	return of elk to appalachi	wilhelm,ej,jr	1967
PADIA	6---6	2	7	ceel	return of the outcast elk	thrapp,dl	1953
VIWIA	11--6	10,	22	ceel	virginia's elk herds	cross,rh	1950
WSCBA	9---4	6	10	ceel	wisconsin's elk herd	reese,sw	1944

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
ANKIA	39--4	141	149	alal	a moose herd is moved	east,b	1936
JWMAA	22--1	51	62	alal	transpl, hndlng tech, n am	pimlott,dh; carbe	1958
NFGJA	17--1	18	32	alal	feasib, stockng in adirond	severinghaus,cw;/	1970
ZEJAA	15--1	6	17	alal	introd in natl park, polan	pielowski,z	1969

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
AMFOA	47--2	55	....	rata	the fight for woodln carib	cox,wt	1941
CAFNA	89--3	299	310	rata	disappear,reintr, cap bret	dauphine,t	1975

rata continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
FDSRA	22...	1	8	rata	intro reinde, falkland isl	bonner,wn	1958
JWMAA	30--3	453	460	rata	raisng car for aleut intro	jones,rd,jr	1966
JWMAA	32--2	350	367	rata	intr,increas,crash,st matt	klein,dr	1968
NPKMA	38---	8	9	rata	wood car comes home, maine	geagan,b	1964

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
AMFOA	53--8	348	349	anam	air-herding the pronghorn	thompson,k	1947
BNMFD	12---	1	103	anam	antelope of new mexico	russell,tp	1964
JWMAA	6---3	231	236	anam	live trapping, texas antel	fisher,lw	1942
JWMAA	6---4	281	286	anam	gather, care, transplnt yg	nichol,aa	1942
JWMAA	31--2	347	351	anam	innova, trapping, handling	spilett,jj; zobel	1967
NAWTA	8----	117	122	anam	wyoming,history,war managm	allred,wj	1943

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CAFNA	81--4	288	289	bibi	albrta bisn movd to quebec	anonymous	1967

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CAFNA	41...	140	....	ovca	rocky mt,transferred,b col	lloyd,h	1927
JWMAA	20--4	467	467	ovca	close gate,live trap,remot	sugden,lg	1956
JWMAA	22--4	445	446	ovca	marking technique for ovca	aldous,mc; craigh	1958
JWMAA	28--3	584	587	ovca	dye-spraying device,markng	hansen,cg	1964
JWMAA	30...	208	209	ovca	modif,dye-markng dev,deser	simmons,nm; phill	1966
NAWTA	11---	364	371	ovca	trap, trnsplnt in colorado	hunter,gn; swen,/	1946
NMWIA	9....	1	2	ovca	banff bighrns for the gila	stewart,rh	1964
tdbca	2----	36	39	ovca	trappng and taggng of ovca	aldous,mc	1958
tdbca	2----	40	42	ovca	trapping on kofa game rang	webb,pm	1958
tdbca	2----	43	46	ovca	transplantng,obs of transp	moore,td	1958
tdbca	2----	51	56	ovca	physic disturb causd,trapp	ham,b	1958
tdbca	3----	42	46	ovca	handling captive,desert ga	devan,ga;van den	1959
tdbca	3----	47	49	ovca	handlng,transportng,desert	moore,td	1959
tdbca	3----	50	52	ovca	use co2 cap-chur gun,deser	devan,ga	1959

ovca continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
tdbca	4----	49	53	ovca	informtn,taggng,desert gam	koplin,jr	1960
tdbca	4----	58	59	ovca	progress,trappng,trans,des	moore,td	1960
tdbca	5----	53	54	ovca	the texas ovca transplant	moore,td	1961
tdbca	5----	56	67	ovca	transplnts, hart mount nat	deming,ov	1961
tdbca	6----	53	56	ovca	devices for tracking ovca	knudsen,mf	1962
tdbca	6----	65	67	ovca	observblty colored ear mar	woodgerd,w; forre	1962
tdbca	6----	129	130	ovca	status transplanted, texas	hailey,tl	1962
tdbca	7----	122	124	ovca	re-establshng native range	yoakum,j	1963
tdbca	7----	149	150	ovca	status transplanted, texas	hailey,tl	1963
tdbca	7----	199	202	ovca	dye-sprayng device, desert	hansen,cg	1963
tdbca	8----	113	116	ovca	status transplanted, texas	hailey,tl	1964
tdbca	9----	6	11	ovca	summ distinctv ovca, nevad	hansen,cg	1965
tdbca	10---	59	61	ovca	status transplanted, texas	hailey,tl	1966
tdbca	11---	27	52	ovca	administ drugs,desert,capt	logsdon,hs	1967
tdbca	11---	53	58	ovca	repr,water util,texas-tran	hailey,tl	1967
tdbca	12---	5	6	ovca	arizona manag and research	russo,jp	1968
tdbca	13---	43	47	ovca	nevada's 1968 trans disapp	broadbent,rv	1969
tdbca	13---	80	85	ovca	status transplanted, texas	hailey,tl	1969

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
IZYBA	6----	229	230	obmo	re-estab in west greenland	andersen,s	1966

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NAHIA	55--1	20	23	oram	transplntng rocky mt goats	white,d	1946

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NATUA	194--	527	528	many	control, introduced, n zea	daniel,mj	1962
NAWTA	5----	409	420	many	intro, transpla, game, n y	bump,g	1940

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	20--4	460	461	dada	aransas ref wldlf introdct	halloran,af; howa	1956

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NAWTA	7----	152	161	----	stocking exper in saskatch	forsyth,es	1942
TRVIA	108-1	130	157	ungu	ecol, mngmnt, intr, n zeal	wodzicki,k	1961

OTHER PUBLICATIONS

Erickson, J. A. 1970. Use of drop net and collars in study of Dall sheep. Trans. Northern Wild Sheep Council pp. 20-21.

Loring, I. A. 1902. The quest for Ovis dalli. New York Zool. Soc. Bull. 7: 46-55.

Nichols, L. 1960. The history of the antelope introductions on Lanai Island, Hawaii. Inter. Antelope Confer. Trans. 11: 101-104.

CHAPTER 22, WORKSHEET 3.2a

Population predictions for trapped and transplanted herds

Suppose that a small herd of some species (bighorn sheep, for example) has been successfully established in an area, but hunting is not yet allowed. Assuming 1:1 sex ratio at birth, use the exponential procedure for predicting populations (PART VI, CHAPTER 19, UNIT 4.2). How many years are required to reach a given population size?

Plot your results in the grid below. Evaluate your predictions with observed increases reported in the literature. If you have used correct reproductive and mortality rates for each of the age classes, the results should be very similar.

UNIT 3.3: TROPHY HUNTING

Trophy hunting is a special type of hunt in which only animals meeting certain criteria, usually size of horns or antlers, are legal game. It has been used with considerable success in bighorn sheep management, where very limited numbers have been removed from designated areas, with 3/4 curl horns or a particular age being minimum requirements.

Some trophy hunts include as few as a dozen hunters. They may be intensively trained, and may be required to carry 15x scopes in the field. Training sessions include information on the biology, physical characteristics and population dynamics of sheep, and information on the area to be hunted. This kind of hunting has the potential for increasing hunter interest and understanding, and only a small percent of participants become involved in illegal activities.

Trophy-hunting only for too many years in succession may result in population growth that will deplete the range and result in smaller animals and fewer trophy-size ones. Then, trophy-hunting is no longer the most appropriate type of hunting; more males and females need to be removed in order to slow population growth or reduce populations to lower levels. Such changes are sometimes hard for the public to understand; they expect trophy-hunting to continue for years when, in reality, it can be only temporary.

Trophy-hunting only has been most often applied to bighorn sheep populations. Such a species is ideally suited to trophy-hunting after successful trap-and-transplant results in an established population that may have a few animals removed by hunting. As the population continues to grow, trophy-hunting only becomes inadequate as a harvest method.

SERIAL REFERENCES, UNIT 3.3

TROPHY HUNTING

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
				rata			

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
tdbca	2----	17	20	ovca	influ trophy hnt,horn size	swank,wg	1958
tdbca	5----	90	94	ovca	legal aspcts, transportatn	merovka,lj	1961
tdbca	9----	82	83	ovca	bighorn hunting proposals	james,s,jr	1965
tdbca	11---	6	7	ovca	hntr indctrnatn progrm,nev	hansen,cg	1967
tdbca	11---	99	113	ovca	boone crockett scores, mgt	bradley,wg	1967

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

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

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

OTHER PUBLICATIONS

Jonez, A. 1966. Trophy for bighorn sheep. Proc. Ann. Conf. of Western Assoc. of State Game and Fish Comm. 46:72-75.

CHAPTER 22, WORKSHEET 3.3a

Population predictions in relation to trophy hunting

Using the procedures referenced in WORKSHEETS 3.1a and 3.2a, evaluate the effects of trophy hunting, or the removal of the biggest and presumably oldest males in the herd by sex and size selection. Make your population predictions, comparing them with the long-term results in previous WORKSHEETS on population predictions.

UNIT 3.4: CASE STUDIES

This UNIT on case studies is included here ti provide a place for a rather lengthy list of SERIAL references which include discussions of particular cases where management practices and programs and described. Most of these pertain to successful programs.

There are many recognized management practices that are parts of successful management programs. In the case of white-tailed deer, a successful management program invoves adequate harvests. In the case of bighorn sheep, a successful management program may involve trappping and transplanting animals to establih new populations. In the case of bison, successful management involves culling older animls for consumptive or non-consumptive uses.

One successful management practice has been the protection of animals from hunting at times when the populations are low. This was mentioned briefly in UNIT 1.2 of this CHAPTER, where it was pointed out that unregulated hunting will cause declines in populations, whereas properly regulated hunting removes an annual surplus that would otherwise depend on the range resources and produce additional animals that would also depend on range resources. Such additions to the population cannot continue without ultimate deterioration of the range. Case studies of established ruminant populations exhibiting long-term productivity will include ecologically reasonable mortality rates.

I would like to make it clear that detailed analyses of the biology of wild ruminants as described in the first 6 PARTS of this 7-PART Series will not result in revolutions in big game management. Successful management programs need not feel threatened. None of my analyses have resulted in surprising managment implications.

The biological analyses presented are refinements in the knowledge and understanding which underlies management decisions. Rather than thinking about and subjectively evaluating relationships, we can now scrutinize them more fully and more rapidly with a large number of equations representing biological functions that may be conveniently and rapidly executed with electronic computing. We humans still do the scrutinizing, not the computers. The computers do the mathematical executions, not us, and they do them much, much faster than we could begin to do them.

Did you know that astronomers in the 14th and 15th century had computers? Their computers were persons hired to do nothing but make the calculations for the astronomer. What took months for these "computers" to do can now be done electronically in hardly more than a fraction of a second.

It is my belief that the better our biological foundations for management, the fewer the chances for errors and the greater the chances for success and public understanding. Thus I and others keep strengthening the foundation by continued research. I hope that this 7-PART Series helps make the relating of research results to management more efficient.

Consider evaluating a management "case," with the additional discipline of converting thoughts and words to numbers. Use data from a successful management program to derive metabolic population structures, weighted mean reproductive and mortality rates, and the other parameters that are needed in the sequence of calculations leading to evaluations of carrying capacity.

A disciplined numerical approach adds dimensions to thought processes that are not otherwise realized.

REFERENCES, UNIT 3.4

CASE STUDIES

BOOKS

TYPE	PUBL	CITY	PGES	ANIM	KEY WORDS-----------------	AUTHORS EDITORS--	YEAR
edbo	acpr	nyny	541	odvi	manag of wetlands, hab imp	wiley,m	1976
aubo	haho	nyny	85	obmo	oomingmak, expedi, nunivak	matthiessen,p	1967
aubo	nmgf	sfnm	212	wldl	new mexico, cons and manag	ligon,js	1927
aubo	naus	nyny	96	wldl	wildlf habitat improvement	shomon,jj; ashba/	1969
aubo	ropr	nyny	129	wldl	wldlf,alaska/an ecol recon	starker,as; darli	1953
aubo	mngf	hemt	238	game	game management in montana	mussehl,tw; howel	1971

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CAFGA	36--3	251	284	od--	basic deer management	dasmann,w	1950
JRMGA	3---4	280	280	od--	new trends in deer managem	dasmann,w	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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JFUSA	71-12	752	757	odvi	manag hab, loblol-short le	halls,mk	1973
JWMAA	12--4	428	432	odvi	management of georgia deer	allen,gw	1948
JWMAA	18--4	482	495	odvi	mgmt study, mud lake, minn	hunt,rw; mangus,l	1954
NAWTA	4----	257	267	odvi	management in s east ohio	chapman,fb	1939
NAWTA	22---	412	424	odvi	wld turkey, manage habitat	davison,ve; graet	1957
NAWTA	22---	501	519	odvi	exprmntl deer yrd mgt, n h	laramie,ha,jr; do	1957
NYCOA	7....	5	....	odvi	adirondack, mgt,wilderness	cheatum,el	1953
NYCOA	8---1	22	23	odvi	mgt problem in southern ny	cheatum,el	1953
NYCOA	31...	18	19	odvi	philosophy of deer managem	severinghaus,cw;/	1976
PIAIA	72---	207	217	odvi	status & managemnt in iowa	kline,pd	1965
TNWSD	1----	358	364	odvi	results of deer management	severinghaus,cw	1958

odvi continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
VIWIA	12--5	22	24	odvi	problems of deer herd mgmt	engle,jw,jr	1951
VIWIA	20--8	5	7	odvi	virginia deer mgmt program	davey,sp	1959
VIWIA	29--4	20	21	odvi	n western vrginia deer hrd	thornton,je	1968
WSCBA	4---2	8	27	odvi	the problem of managng dee	swift,e	1939
WSCBA	14--4	3	6	odvi	deer management in minneso	blair,fd	1949
WSCBA	22--8	6	10	odvi	the deer unit, survey, mgt	keener,jm; thomps	1957
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	7----	1	195	odhe	kaibab hrd; his, prob, mgt	russo,jp	1964
CAFGA	36--3	251	284	odhe	basic deer management	dasmann,w	1950
CAFGA	36--4	343	365	odhe	califor, chaparral forests	cronemiller,fp; b	1950
CFGGA	4----	1	139	odhe	the jawbone deer herd	leopold,as; /	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	3----	368	375	odhe	mngmnt, kaibab plat, arizo	boone,rp	1938
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
JRMGA	3---4	279	280	ceel	elk management problems	cooney,rf	1951
NAWTA	7----	375	379	ceel	managing nebo's wapiti	olsen,o	1942
NAWTA	12---	204	211	ceel	plnning mgt programs,herds	rasmussan,di; dom	1947
NZTBA	36...	429	463	ceel	conditn, ecol, mngmnt, n z	riney,ta	1955
SFORA	21--1	15	18	ceel	mangmnt, control, scotland	macnally,l	1967
TRVIA	108-1	9	40	ceel	hist, status, consrv, scot	lowe,vpw	1961
WGFBA	10---	1	184	ceel	elk of jackson hol; studie	anderson,cc	1958
XFIPA	24---	1	15	ceel	od, prob,hab mgt,n forests	lyon,lj	1966

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	18---	539	552	alal	progress in mngmnt,s alask	spencer,dl; chate	1953
NCANA	101-1	643	656	alal	manag, conif ecotone, n am	karns,pd; haswel/	1974
NCANA	101-3	657	671	alal	some aspects of man, newfo	mercer,we; manuel	1974
NCANA	101-3	673	687	alal	manage in ontario, 1948-73	cumming,hg	1974
NCANA	101-3	705	721	alal	moose management in alaska	rausch,ra; somer/	1974
NCANA	101-3	723	735	alal	manag in norway and sweden	lykke,j	1974
WLSBA	4---4	167	174	alal	odvi, hist manage, finland	salo,lj	1976

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CAUDA	25--5	144	149	rata	bar-grnd carib & managemnt	kelsall,jp	1963
JWMAA	31--4	621	642	rata	manageme of labrador carib	bergerud,at	1967
SALKA	27---	240	241	rata	porcupine herd mgmnt needs	jakimchuk,rd	1976

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NAWTA	3----	381	387	anam	life history, mgmt, oregon	einarsen,as	1938
NAWTA	4----	216	220	anam	oregon's open season, 1938	einarsen,as	1939
NAWTA	7----	152	161	anam	stockng experienc,saskatch	forsyth,es	1942
NAWTA	8----	117	122	anam	history,wartime mgt,wyomng	allred,wj	1943
NAWTA	11---	274	279	anam	controlled hunts, problems	lay,dw	1946
tdbca	4----	104	106	anam	ovca, sheep, antlp, mexico	davila,cja	1960

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NAWTA	9----	135	143	bibi	restoration of wild bison	cahalane,vh	1944
ORYXA	7---6	305	314	bibi	canad; save fr extinc, mgt	egerton,pjm	1964
TRVIA	108-2	286	304	bibi	ecol and mangmnt, amer bis	fuller,wa	1961

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CAFGA	43--3	179	191	ovca	surv,santa rosa mts, calif	jones,fl; flittn/	1957
IGWBA	1----	1	154	ovca	statu, lif hist, mgt, idah	smith,dr	1954
NAWTA	4----	253	256	ovca	ecol, mngmnt, mt rang, nev	allen,jc	1939
NAWTA	14---	527	536	ovca	desert bighorn management	halloran,af	1949
tdbca	3----	58	66	ovca	death valley bghrn project	welles,re	1959
tdbca	4----	41	44	ovca	mgt recommendatns, arizona	kelly,we	1960
tdbca	4----	45	46	ovca	bghrn as multiple use anim	jonez,a	1960
tdbca	5----	7	8	ovca	past, present status,n mex	gross,je	1961
tdbca	5----	51	52	ovca	bighrn managemnt in mexico	arellano,lm	1961
tdbca	6----	126	128	ovca	prog pop,mgt invstgtns,n m	larsen,pa	1962
tdbca	7----	1	11	ovca	history in central nevada	mccolm,ma	1963
tdbca	7----	72	....	ovca	desert bghrn study, part 1	simmons,nm	1963
tdbca	9----	40	48	ovca	hstry, california & nevada	barrett,rh	1965
tdbca	11---	13	15	ovca	public domain, arizona big	powell,le	1967
tdbca	11---	86	93	ovca	15 years hunting, arizona	russo,jp	1967
tdbca	13---	1	5	ovca	hunt surv,hab develop,utah	john,rt	1969
tdbca	13---	71	75	ovca	hunt reslts 1968-69, nevad	barngrover,lw	1969

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
BICOB	3---4	255	263	obmo	managem controvers, n amer	lent,pc	1971

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
IGWBA	2----	1	142	oram	life history, mgtmt, idaho	brandborg,sm	1955

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	34--4	800	812	many	game managem in yugoslavia	isakovic,i	1970
TRVIA	108--	181	202	many	mngmnt, land use, u states	petrides,ga	1961
TRVIA	108--	181	202	many	mngmnt, land use, u states	petrides,ga	1961

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
JFUSA	38--1	27	30	wldl	mgmt south jersey pine bar	moore,eb	1940
JFUSA	48-10	700	702	wldl	cooperative mana, virginia	mosby,hs	1950
JFUSA	69-10	736	740	game	prod and harvest, czechosl	reynolds,hg	1971
JWMAA	13--4	392	411	biga	biga management, colorado	hunter,gn; yeager	1949
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
MAMLA	22--2	317	322	ungu	conservatn & the ungulates	darling,ff	1958
NAWTA	12---	204	211	biga	planning wstrn mgt progrms	rasmussan,di; dom	1947
NAWTA	17---	437	447	biga	applicat practicl mgt tech	hunter,gn	1952
NAWTA	24---	472	479	biga	mangmnt in the lake states	ruhl,hd	1959
TRVIA	108-1	130	157	ungl	ecol, mngmnt, intr, n zeal	wodzicki,k	1961

OTHER PUBLICATIONS

Hay, K. G., G. N. Hunter, and L. Robbins. 1961. Big game management in Colorado 1949-1958. Colo. State Depart. Game and Fish, Denver. Tech. Bull. No. 8. 112 p.

CHAPTER 22, WORKSHEET 3.4a

Case Studies -- your choice of species and area

The WORKSHEETS in this PART VII are more general and shorter than those in the first six PARTS. They are more comprehensive, however, as the results of previous calculations are put together in the management context.

Use this UNIT on case studies as a stimulus to comprehensive thinking, incorporate as many biological factors as possible into a case study of a species and area of your choice.

List the factors below, with references to the PARTS, CHAPTERS, and UNITS which contain basic information to be used. Then, complete your case study on your own paper, making it not only as up-to-date but also as futuristic as possible.

CLOSING COMMENTS

The concepts that have been presented in the first twenty-two CHAPTERS provide a framework for thought-processes, a logic that permits rather complex analyses of biological functions. An understanding of these biological functions helps place decision-making on a sound base, with greater returns from management practices. If this approach is valuable now, how much more valuable it will be in the future when resources are managed even more intensively. The next CHAPTER includes discussions of improper range use, providing the reader with examples of what not to do. The progression from positive biological examples in the first twenty-two CHAPTERS to negative ones in CHAPTER 22 is deliberate. Learn what should be done before focusing on what shouldn't be done.

Aaron N. Moen
March 9, 1982

GLOSSARY OF SERIAL CODENS - CHAPTER TWENTY-TWO

Serials are identified by five-character, generally mnemonic codes called CODEN, listed in 1980 BIOSIS, LIST OF SERIALS (BioSciences Information Service, 2100 Arch Street, Philadelphia, PA 19103).

The headings for the lists of SERIALS are:

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

The volume and issue numbers (VO-NU) are given after the CODEN entry, followed by beginning page (BEPA), ending page (ENPA), species discussed (ANIM)1, KEY WORDS from the title, AUTHORS [truncated if necessary, slash (/) indicates additional authors], and YEAR.

AIWHA Animals (London)
ALCNA Alabama Conservationist
AMFOA American Forests
AMNAA American Midland Naturalist (US)
AMNTA American Naturalist
ANKIA Animal Kingdom, New York Zoological Society Bulletin
APLCA Appalachia
ATICA Arctic (Canada)
AUMGA Audubon Magazine
AZWBA Arizona Game and Fish Department Wildlife Bulletin (US)

BEHAA Behaviour (Netherlands)
BICOB Biological Conservation
BNMFD New Mexico Department of Game & Fish Bulletin
BPURD Biological Papers of the University of Alaska Special Report

CAFGA California Fish and Game (US)
CAFNA Canadian Field Naturalist (Canada)
CAUDA Canadian Audubon
CFGGA California Department of Fish and Game, Game Bulletin
CGFPA Colorado Division of Game, Fish, and Parks Special Report (US)
CJZOA Canadian Journal of Zoology
CNSVA Conservationist
CWOPA Canadian Wildlife Service Occassional Paper (Canada)
CWRSB Canadian Wildlife Service Report and Management Bulletin Series

DRCWD Colorado Division of Wildlife Division Report

ECMOA Ecological Monographs (US)

FDSRA Falkland Islands Dependencies Survey Scientific Reports
FOSCA Forest Science (US)
FUNAA Fauna (Oslo)

HEREA Hereditas (Sweden)
HILGA Hilgardia

ICNSA Iowa Conservationist
IGWBA Idaho Department of Fish and Game Wildlife Bulletin
IZYBA International Zoo Year Book

JANSA Journal of Animal Science (US)
JAZAA Journal of the Arizona Academy of Science (US)
JFUSA Fournal of Forestry (US)
JOMAA Journal of Mammalogy (US)
JRMGA Journal of Range Management (US)
JTBIA Journal of Theoretical Biology
JWMAA Journal of Wildlife Management (US)

MAMLA Mammalia (France)
MDCBA Minnesota Department of Conservation Technical Bulletin
MDCRA Michigan Department of Conservation Game Division Report (US)
MOCOA Missouri Conservationist
MRLTA Murrelet, The
MRYCA Maryland Conservationist
MUZPA Miscellaneous Publications, Museum of Zoology, University of Michigan

NAHIA Natural History
NATUA Nature (England)
NAWTA North American Widlife and Natural Resources Conference,
    Transactions of the (US)
NCANA Naturaliste Canadien, Le
NFGJA New York Fish and Game Journal (US)
NMCBA National Museum of Canada Bulletin
NMWIA New Mexico Wildlife
NOSCA Northwest Science (US)
NPKMA National Parks Magazine
NPSMD United States National Park Service Scientific Monograph Series
NTCNB Nature Canada (Canada)
NTRLA Naturalist, The (Leeds)
NWGRA National Wool Grower
NYCOA New York State Conservationist
NZTBA New Zealand Journal of Science and Technology Section B

ORYXA Oryx

PADIA	Pacific Discovery
PASCC	Proceedings of the Alaskan Scientific Conference (US)
PCGFA	Proceedings of the Southeastern Association of Game and Fish Commissioners
PIAIA	Proceedings of the Iowa Academy of Science (US)
PMACA	Papers of the Michigan Academy of Sciences, Arts and Letters
PSDAA	Proceedings of the South Dakota Academy of Science
PZSLA	Proceedings of the Zoological Society of London
QRBIA	Quarterly Review of Biology
RWLBA	Roosevelt Wild Life Bulletin
SALKA	Science in Alaska Proceedings Alaskan Science Conference
SCBUB	Sierra Club Bulletin
SFORA	Scottish Forestry
SYLVA	Sylva
* tdbca	Transactions of the Desert Bighorn Council
TNWSD	Transactions of the Northeast Section, The Wildlife Society
TRVIA	Terre Vie (La Terre et la Vie)
TWASA	Transactions Wisconsin Academy of Sciences, Arts, and Letters
UABPA	Biological Papers of the University of Alaska
UAECA	Utah Agricultural Experiment Station Circular
UCPZA	University of California Publications in Zoology
VIWIA	Virginia Wildlife
VJSCA	Virginia Journal of Science
VLUBB	Vestnik Leningradskogo Universiteta Biologiya
WCDBA	Wisconsin Conservation Department Technical Bulletin
WGFBA	Wyoming Game and Fish Commission Bulletin
WLMOA	Wildlife Monographs (US)
WLSBA	Wildlife Society Bulletin
WMBAA	Wildlife Management Bulletin (Ottowa) Series 1 (Canada)
WSCBA	Wisconsin Conservation Bulletin
WUARA	Wisconsin Agricultural Experiment, Research Bulletin
XENCA	See XFNCA
XFIPA	U S Forest Service Research Paper INT (US)
XFNCA	U S Forest Service Research Paper NC (US)
XFRMA	U S Forest Service Research Paper RM (US)
XFSWA	U S Forest Service Research Paper WO (US)

*No BIOSIS CODEN

XFWLA U S D I Fish and Wildlife Service, Wildlife Leaflet
XFWWA U S Fish and Wildlife Service Special Scientific Report - Wildlife
XIBPA U S-IBP (Internation Biological Program) Analysis of Ecosystems Program Interbiome Abstracts
XIWFA U S D A, Biological Survey, North American Fauna
XNFSA U S National Park Service Fauna of the National Parks of the United States, Fauna Series

ZEJAA Zeitschrift fuer Jagdwissenschaft
ZOOLA Zoologica (New York)

LIST OF PUBLISHERS - CHAPTER TWENTY-TWO

The headings for the lists of BOOKS are:

TYPE PUBL CITY PAGE ANIM KEY WORDS---------------- AUTHORS/EDITORS-- YEAR

All essential information for finding each book in the library is given on just one line. The TYPE of book could have either AUTHORS (aubo) or EDITORS (edbo). Publishers (PUBL) and CITY of publication are given with four-letter mnemonic symbols defined below. The PAGE column gives the number of pages in the book; ANIM refers to the species discussed in the book (given as a four-letter abbreviation of genus and species), and KEY WORDS listed are from the title. The AUTHORS/EDITORS and YEAR of publication are given in the last two columns.

aakn	Alfred A. Knopf	New York, NY	nyny
acpr	Academic Press	New York, NY	nyny
blhp	Blue Heron Press		
blsp	Blackwell Scientific Publications	Oxford, England	oxen
cite	Cambridge Institute of Terrestrial Ecology	Cambridge, England	caen
codw	Colorado Division of Wildlife	Denver, CO	deco
coup	Cornell University Press	Ithaca, NY	itny
cscs	Charles Scribner's Sons	New York, NY	nyny
dalt	Dalton	Lavenheim, England	laen
dche	D. C. Heath	Boston, MA	boma
dodo	Doubleday Doran	New York, NY	nyny
doup	Doubleday, Pace, & Co.	New York, NY	nyny
fost	Forest and Stream Publishing Co.	New York, NY	nyny
haho	Hastings House Publishers	New York, NY	nyny
holt	Holt	New York, NY	nyny
iucn	International Union for the Conservation of Nature and Natural Resources	Morges, Switzerland	mosw
jhpr	John Hopkins Press	Baltimore, MD	bamd

macm	MacMillan Co.	New York, NY	nyny
mhbc	McGraw-Hill Book Company, Inc.	New York, NY	nyny
mngf	Montana Game and Fish Dept.	Helena, MT	hemt
naus	National Audubon Society	New York, NY	nyny
nhfg	New Hampshire Fish and Game Dept.	Concord, NH	conh
nmgf	New Mexico Game and Fish Dept.	Santa Fe, NM	sfnm
nyzs	New York Zoological Society	New York, NY	nyny
omcc	Olin Mathieson Chem. Corp.	East Alton, IL	eail
oxup	Oxford University Press	London, England	loen
qupr	Queen's Printer	Ottawa, Ontario	oton
repu	Reinhold Publishing	New York, NY	nyny
rokp	Routledge & K. Paul	London, England	loen
ropr	Ronald Press	New York, NY	nyny
rowa	Rowland Ward	London, England	loen
scri	Charles Scribner's Sons	New York, NY	nyny
stac	The Stackpole Company	Harrisburg, PA	hapa
swap	Swallow Press	Athens, OH	atoh
thcr	Thomas Crowell Co.	New York, NY	nyny
uaec	U. S. Atomic Energy Commission	Oak Ridge, TN	ortn
ucap	University of California Press	Berkeley, CA	beca
uchp	University of Chicago Press	Chicago, IL	chil
ukap	University of Kansas Press	Lawrence, KA	laka
unbp	University of Nebraska Press	Lincoln, NE	line
uopr	University of Oklahoma Press	Norman, OK	nook
usgp	U. S. Government Printing Office	Washington, DC	wadc
utop	University of Toronto Press	Toronto, ON	toon
uwyp	University of Wyoming Press	Laramie, WY	lawy
vipr	Viking Press	New York, NY	nyny
whfr	W. H. Freeman Company	San Francisco, CA	sfca
wimi	Wildlife Management Institute	Washington, DC	wadc
winp	Winchester Press	New York, NY	nyny
wiwe	Winchester-Western Press	East Alton, IL	eail

GLOSSARY OF ANIMAL CODE NAMES

Wild ruminants are referred to in this CHAPTER by a 4-character abbreviation from the family, genus and genus-species. These are listed below under Abbreviation.

Scientific names of North American wild ruminants are those used in BIG GAME OF NORTH AMERICA, edited by J.C. Schmidt and D. L. Gilbert (1979: Stackpole Books, Harrisburg, PA 17105, 494 p.), and may be different from the scientific names given in the original literature.

The abbreviations used for North American wild ruminants are listed below.

CLASS: MAMMALIA

ORDER: ARTIODACTYLA	Abbreviation
FAMILY: CERVIDAE	cerv
GENUS: *Odocoileus* (deer)	od--
SPECIES: *O. virginianus* (white-tailed deer)	odvi
O. hemionus (mule deer)	odhe
GENUS: *Cervus* (Wapiti, elk)	ce--
SPECIES: *C. elaphus*	ceel
GENUS: *Alces* (moose)	
SPECIES: *A. alces*	alal
GENUS: *Rangifer* (caribou)	
SPECIES: *R. tarandus*	rata
FAMILY: ANTILOCAPRIDAE	
GENUS: *Antilocapra*	
SPECIES: *A. americana* (pronghorn)	anam
FAMILY: BOVIDAE	bovi
GENUS: *Bison* (bison)	bi--
SPECIES: *B. bison*	bibi
GENUS: *Ovis* (sheep)	ov--
SPECIES: *O. canadensis* (bighorn sheep)	ovca
O. dalli (Dall's sheep)	ovda
GENUS: *Ovibos*	
SPECIES: *O. moschatus* (muskox)	obmo
GENUS: *Oreamnos*	
SPECIES: *O. americanus* (mountain goat)	oram

The abbreviations used for European wild ruminants are listed below.

CLASS: MAMMALIA

ORDER: ARTIODACTYLA	Abbreviation
FAMILY: CERVIDAE	cerv
GENUS: Capreolus (roe deer)	ca--
SPECIES: C. capreolus	caca
GENUS: Dama (fallow deer)	da--
SPECIES: D. dama	dada
GENUS: Cervus (Wapiti, elk)	ce--
SPECIES: C. elaphus (red deer)	ceel
GENUS: Alces (moose)	
SPECIES: A. alces	alal
GENUS: Rangifer (caribou)	
SPECIES: R. tarandus	rata
FAMILY: BOVIDAE	
GENUS: Bison (bison)	
SPECIES: B. bonasus	bibo
GENUS: Capra (ibex, wild goat)	cp--
SPECIES: C. aegargrus(Persian ibex)	cpae
C. siberica (Siberian ibex)	cpsi

OTHERS

Abbreviations for a few other species and groups of species may appear in the reference lists. These are listed below.

Axis axis (axis deer)	axax
Elaphurus davidianus (Pere David's deer)	elda
Cervus nippon (Sika deer)	ceni
Hydropotes inermis (Chinese water deer)	hyin
Muntiacus reevesi (Chinese muntjac)	mure
Moschus moschifer (Chinese musk deer)	momo
Ovis nivicola (snow sheep)	ovni
Ovis musimon (moufflon)	ovmu
Ovis linnaeus (Iranian sheep)	ovli
Rupicapra rupicapra (chamois)	ruru
big game	biga
domestic sheep	dosh
domestic cattle	doca
domestic goat	dogo
domestic ruminant	doru
herbivore	hrbv
mammals	mamm
three or more species of wild ruminants	many
ruminants	rumi
ungulates	ungu
vertebrates	vert
wildlife	wldl
wild ruminant	wiru

JULIAN DAY: MONTH AND DAY EQUIVALENTS*

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Day
1	001	032	060	091	121	152	182	213	244	274	305	335	1
2	002	033	061	092	122	153	183	214	245	275	306	336	2
3	003	034	062	093	123	154	184	215	246	276	307	337	3
4	004	035	063	094	124	155	185	216	247	277	308	338	4
5	005	036	064	095	125	156	186	217	248	278	309	339	5
6	006	037	065	096	126	157	187	218	249	279	310	340	6
7	007	038	066	097	127	158	188	219	250	280	311	341	7
8	008	039	067	098	128	159	189	220	251	281	312	342	8
9	009	040	068	099	129	160	190	221	252	282	313	343	9
10	010	041	069	100	130	161	191	222	253	283	314	344	10
11	011	042	070	101	131	162	192	223	254	284	315	345	11
12	012	043	071	102	132	163	193	224	255	285	316	346	12
13	013	044	072	103	133	164	194	225	256	286	317	347	13
14	014	045	073	104	134	165	195	226	257	287	318	348	14
15	015	046	074	105	135	166	196	227	258	288	319	349	15
16	016	047	075	106	136	167	197	228	259	289	320	350	16
17	017	048	076	107	137	168	198	229	260	290	321	351	17
18	018	049	077	108	138	169	199	230	261	291	322	352	18
19	019	050	078	109	139	170	200	231	262	292	323	353	19
20	020	051	079	110	140	171	201	232	263	293	324	354	20
21	021	052	080	111	141	172	202	233	264	294	325	355	21
22	022	053	081	112	142	173	203	234	265	295	326	356	22
23	023	054	082	113	143	174	204	235	266	296	327	357	23
24	024	055	083	114	144	175	205	236	267	297	328	358	24
25	025	056	084	115	145	176	206	237	268	298	329	359	25
26	026	057	085	116	146	177	207	238	269	299	330	360	26
27	027	058	086	117	147	178	208	239	270	300	331	361	27
28	028	059	087	118	148	179	209	240	271	301	332	362	28
29	029	[060]	088	119	149	180	210	241	272	302	333	363	29
30	030		089	120	150	181	211	242	273	303	334	364	30
31	031		090		151		212	243		304		365	31

* For leap year, February 29 = JDAY 60. Add 1 to all subsequent JDAYs.

LIST OF WORKSHEETS - CHAPTER TWENTY-TWO

THE BIOLOGY AND MANAGEMENT OF WILD RUMINANTS

CHAPTER TWENTY-THREE

IMPROPER RANGE USE

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

First printing, March 1982

Library of Congress Catalog Number 80-70984

CONTENTS OF CHAPTER TWENTY-THREE

IMPROPER RANGE USE

CHAPTER 23. IMPROPER RANGE USE

I do not like to be negative, choosing rather to emphasize the positive, the solutions that work rather than those that don't. Yet there is a body of literature that describes problems that have arisen as a result of certain management decisions, and the causes of those problems can sometimes be identified.

Regulations governing the management of wild ruminants are often in the hands of legislators. This is not, in itself bad. Legislators, however, are seldom knowledgable about ecological relationships, and under the democratic system of government they are expected to represent their constituency as much as possible. It is hard for the majority of legislators--and indeed for the majority of people--to understand that limited resources cannot be stretched indefinitely, and that the laws of society must be subordinate to the laws of nature.

On the whole, legislators are no better qualified to propose effective wildlife programs than, for example, the teamsters' union is capable of predicting next year's wheat crop. Game management simply is not their province. Ecological decisions must be in the hands of specialists, and the public and lawmakers must both understand that the laws of nature are paramount. This places an extraordinary responsibility on the ecologist.

Laws should not be enacted to solve problems, but rather to prevent them. Regulations should--and can--be changed before problems develop. No one, of course, can predict or prevent the effects of an occasional unfortunate act of nature on wildlife populations, but over the long haul we can prevent such from being disastrous, and minimize immediate effects.

Differences of opinion on management programs cannot be settled by sentiment or by "demands." Decisions must be based on ecological relationships if we are to retain a viable ecosystem. That is essential if we are to preserve natural life, including human life. Human compromises must not violate biological laws. Wildlife management cannot be an expression of the will of the majority if that will results in the destruction of natural resources faster than they can be replaced. This is a matter of self-preservation.

The realization of the importance of ecological relationships is so recent that we have, in the mistaken belief that resources are inexhaustible and that economic growth is limitless, allowed the conflict between ecology and economics to get completely out of hand. In our desire to improve conditions, we have allowed economics to over-shadow ecology. A high standard of living, an abundance of luxuries . . . are of little consequence if natural laws are not recognized and respected.

In spite of the recent interest in the environment, there is little real understanding of the underlying principles of animal-environment relationships, and of population dynamics. Some environmentalists consider preservation of the environment as having something to do with improving its appearance, which may take the form of anything from picking up beer bottles and waste paper to creating city playgrounds. Others think is is leaving everything "natural," forgetting where food for city-dwellers and suburbanites--the major part of the United States population--comes from. Preservation of the environment is something vastly more essential--it is living within the basic physical and chemical "laws" and keeping populations within the carrying capacity of the world.

The concepts presented in the first twenty-two CHAPTERS of this SEVEN-PART SERIES are not unique to wild ruminants. They may be applied to any species, including humans. There is a vast accumulation of all sorts of data on natural phenomena--weather, space, soils, forests, nutritional needs, populations-- much of it collected by the U. S. Census Bureau ever since the beginning of this country that can be used in decision making. We can simulate situations and come up with reasonable approximations of expected results. The data, the technology, the analytical procedures . . . are far more advanced than the human's willingness to apply what is known, whether to wild ruminant problems, or human ones. I have personally sat in a room filled with specialists (experts!) on the environment, each one of us representing a special area of environmental concern, discussing minimum standards for air quality and minimum tolerances of life to chemicals in the environment. Yet the smoke emanating from some of those participants filled the room, making it most uncomfortable for those of us present who consider air pollution to be not only uncomfortable, but hazardous to health and life. How can experts arrive at decisions affecting the health and well-being of plants and animals if they are oblivious to their own health and well-being?

Traveling through airports, I am often confronted by sign-carrying "environmentalists" concerned about nuclear energy use. How many of them would be willing to support complete abolition of alcoholic beverages? Yet alcohol is associated with about 40,000 to 50,000 deaths in automobile accidents <u>each year</u>, not to mention the broken homes, broken lives, and misery that is experienced by families and friends of those involved in alcohol abuse. Need I mention the drug abuse problem throughout the world?

With so many examples of improper "range use" by humans, I wonder why anyone should be concerned about a few deer dying, or an overused elk range, or the permitting of hunting, or the abolition of hunting . . .

Humans are the funniest people, excessively sophisticated and yet almost pitifully ignorant.

REFERENCES, CHAPTER 23

IMPROPER RANGE USE

BOOKS

TYPE PUBL CITY PGES ANIM KEY WORDS----------------- AUTHORS/EDITORS-- YEAR

OTHER PUBLICATIONS

Proceedings of the White-tailed Deer in the Southern Forest Habitat Symposium (First meeting in 1962)

Transactions of the Annual Meeting of the Northeast Deer Study Group (Annual meeting beginning 1964)

Proceedings of the North American Moose Conference (Fifth conference in 1968)

Proceedings of the International Reindeer/Caribou Symposium (First meeting in 1977, second in 1980)

Proceedings of the Biennial Antelope States Workshop

Transactions of the Interstate Antelope Conference

Transactions of the North American Wild Sheep Conference (Second meeting in 1976)

Transactions of the Desert Bighorn Council (Annual meeting beginning 1957)

Proceedings of the International Mountain Goat Symposium

Proceedings of the Annual Conference of Western Association of State Game & Fish Commissioners (Annual conference beginning 1921)

TOPIC 1. OVERPOPULATION EFFECTS

Overpopulation, or the exceeding of the carrying capacity of a range, has definite ecological effects on both animals and range. One of the most obvious effects is malnutrition and death of animals. Less obvious effects of overpopulation appear earlier than death, but are much more subtle and more difficult to recognize. More or less regular contact is needed over a period of several years if changes are to be recognized as a result of increasing populations. Further, it is necessary to know the signs to look for on the range.

The first UNIT in this TOPIC includes examples and references pertaining to malnutrition as a result of over population. Effects may be as obvious as death from starvation, or as subtle as a slight drop in reproductive rates.

The second UNIT includes examples and references pertaining to excessive competition between herbivores. Note the emphasis on excessive. Different species of ruminants may coexist on the same area because of differences in food habits, behavior, etc. (see PART II, CHAPTER 5).

The third UNIT includes examples of range responses to improper use. These three UNITS are examples of effects, of what happens as a result of overpopulation of large animals such as wild ruminants. The next TOPIC includes discussions and references on the causes of overpopulation.

UNIT 1.1: MALNUTRITION

Malnutrition is a common characteristic of the youngest age classes in many populations of wild ruminants. Why? Because they simply have not lived long enough to grow large enough to put away body reserves to carry them through rough times. They are like small businessmen with little capital, often barely hanging on, and the first to succumb when the financial environment becomes unfavorable.

Because of the age effect discussed above, malnutrition must be considered natural in the sense that some animals--late-born fawns, for example--are "born losers," almost certain to die even in a typical winter. Such deaths should not be attributed to poor range conditions. It may be that fawns born in July or August, conceived in December or January, were the offspring of year-old dams who not only conceived late, but may also have been low milk producers as well as inexperienced mothers.

In the natural world, such a set of circumstances almost inevitably results in malnutrition and subsequent death.

It may be that the range has ample forage, but excessive snow limits the animals' mobility, confining a herd to an unusually small area for a long time. Is the resulting malnutrition the result of mismanagement and overpopulation? Not necessarily so.

The question is often asked ". . .why don't we feed the excess deer? The answer is simple . . .cost . . ." (Severinghaus 1975). How much does it cost to feed a group of wild ruminants? The basic calculations of metabolic requirements have been made previously (Ecological Metabolism in CHAPTER 7, UNIT 6.1); it is necessary here to simply format our knowledge into an appropriate framework for a cost analysis. This is done in WORKSHEET 1.1a.

What are the symptoms of malnutrition in wild ruminants? It is important to realize that a weight fluctuation from an autumn high to a late winter low is a natural cyclic phenomenon (see Moen and Severinghaus 1981; also PART I, CHAPTER 1, UNIT 1.4). Malnutrition becomes a serious problem to the individual when an animal approaches too closely or reaches the weight of no return.

What are the symptoms of malnutrition? The fat deposits, accumulated during the summer and fall, are depleted in a natural sequence. First, fat between the hide and musculature disappears. This happens every year, and is part of the normal weight loss. Second, fat inside the body cavity disappears. This too is normal, up to a point. When these reserves are nearly depleted, there is little fat left to mobilize. Then, bone marrow fat and other deposits not easily observed are mobilized, and malnutrition is present. The sequence is not perfect nor clearly evident in all cases, as pointed out by Ransom (1965).

Chronic malnutrition results in depressed growth rates and high levels of mortality. There are numerous published papers on the subject as results of dead deer counts have been used to document the need for herd control.

LITERATURE CITED

Ransom, A. B. 1965. Kidney and marrow fat as indicators of white-tailed deer condition. J. Wildl. Manage. 29(2):397-398).

Severinghaus, C. W. 1975. Advances in the science of deer management. The Conservationist 29(4):18-20.

REFERENCES, UNIT 1.1

MALNUTRITION

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
AMFOA	51--1	13	15	od--	killing deer by kindness	carhart,ah	1945
AUMGA	47--2	74	79	od--	deer trouble, overpopulatn	cook,db	1945
JWMAA	2---1	1	2	od--	prevntng deer concentratns	cox,wt	1938
JWMAA	3---4	295	306	od--	n yellwstn wint rang studi	grimm,rl	1939
NAWLA	7---1	46	47	od--	feeding deer to death	giles,rh,jr; mcki	1968
NAWTA	8----	333	337	od--	fallacies in winter feedng	carhart,ah	1943
NAWTA	9----	167	172	od--	murderers creek herd, oreg	mitchell,ge	1944

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
AMFOA	42-10	463	465	odvi	starv, n mich winter kill	east,b	1936
ANKIA	62--4	106	110	odvi	our white-tail deer problm	stenlund,m	1959
CNSVA	2---4	21	21	odvi	winter deer feeding	darrow,rw	1948
CNSVA	3---5	19	22	odvi	bone marrow index, malnutr	cheatum,el	1949
CNSVA	10--1	39	39	odvi	winter deer kill, 1954-55	n y conserva dept	1955
CNSVA	10--6	2	4	odvi	too many deer	cheatum,el	1956
CNSVA	19--3	8	9	odvi	winter deer feeding	hesselton,wt	1964
CNSVA	29--4	18	20	odvi	advances, science of mngmt	severinghaus,cw	1975
JWMAA	9---4	319	322	odvi	symptoms of malnutrition	harris,d	1945
JWMAA	14--2	156	161	odvi	histopath chng, starv,wisc	rausch,r	1950
JWMAA	21--2	245	247	odvi	marsh deer die-off in loui	glasgow,ll; ensmi	1957
JWMAA	29--2	397	398	odvi	kidney, marrow fat, indica	ransom,ab	1965
JWMAA	39--4	813	814	odvi	wint field test,food block	anderson,rh; you/	1975
NAWTA	4----	268	274	odvi	results, feeding exp, mich	davenport,la	1939
PCGFA	20---	134	137	odvi	mandib cav tiss,indic cond	baker,mf; lueth,f	1966
PCGFA	21---	15	23	odvi	eff ovrpop, huntng,ft knox	dechert,ja	1967
WSCBA	2---9	3	9	odvi	to citizens of wisconsin	mackenzie,hw	1937
WSCBA	7---9	8	10	odvi	famine stalks the deer,wis	feeny,ws	1942
WSCBA	13-12	22	22	odvi	too many deer, pennsylvani	anonymous	1948
WSCBA	14---	18	19	odvi	deer starve at feedi statn	stollberg,bp	1949

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	8---4	317	338	odhe	supplmntl wint feedng, uta	domen,er; rasmuss	1944
JWMAA	29--2	352	365	odhe	stomach cont, conditn, n m	anderson,ae; sny/	1965
JWMAA	36--2	579	594	odhe	indices of carcas fat, col	anderson,ae; med/	1972
JWMAA	38--4	815	822	odhe	eff starvatn, rumen bacter	decalesta,ds; na/	1974
NAWTA	14---	502	512	odhe	problm areas,westrn states	aldous,cm	1949
PMASA	19...	72	79	odhe	annual cycle conditn, mont	taber,rd; white,/	1959

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	8---1	1	6	ceel	private game pres,ovrstock	dalke,pd; spencer	1944
NEJZA	26--3	448	....	ceel	ecolo, wint feedng, sctlnd	wiersema,gj	1976
NZSTB	36--5	429	463	ceel	eval condit, free rang dee	riney,t	1955

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NAWTA	1----	396	398	alal	malnutr, decline, isle roy	hickie,pf	1936
NAWTA	11---	296	306	alal	present status, isle royal	aldous,se; krefti	1946

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	34--4	904	907	rata	dried marrow wt, fat indic	neiland,ka	1970

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
				oram			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JOMAA	22--1	47	53	biga	det proper wint forag util	swift,lw	1941

UNIT 1.2: COMPETITION BETWEEN HERBIVORES

Competition between some of the different species of wild ruminants and between wild and domestic ruminants is inevitable because many of the species live on the same range. Their behavior patterns are not identical (See PART II, CHAPTER 5) nor are are their food habits (See PART IV, CHAPTER 12). Thus the extent of competition between herbivores varies, depending ono species, areas, and population levels.

It is important to realize that population levels are a prime determinant of the extent of competition, and that too many of the same species results in competition between herbivores too, even if they have the same scientific name but are of different ages, sexes, sizes, and dominance classes.

The extent of competition also depends on the amount of overlap in areas used. There is an effective reduction in competition within most species during the summer when animals space themselves out, establishing at least loosely-defined maternal territories. Different species share areas to different extents, with no overlap for some (caribou and bighorn sheep, for example), and considerabale overlap for others (white-tailed and mule deer in the Western States, for example).

Another kind of herbivore competition that should be given more attention than it has in the past is the competition between herbivores of different orders, classes, and even phyla. The competition between snowshoe hare and white-tailed deer, for example, may be greater than realized. Direct competition is not the rule, but the hares may browse on some of the same forages that deer do, though at different stages in plant growth. There is also competition between different orders; deer and turkey compete for acorns, for example. There is also competition between large herebivores, such as wild ruminants, and small herbivores, such as insects. The amount of such competition varies from year to year, primarily because of large fluctuations in insect populations.

When does competition between herbivores become excessive? There is no simple answer to that question. I attended a seminar recently on the question of whether there was competition between domestic cattle and wild ruminants in Africa. The concluding answer was "no." How frustrating to listen to an hour-long talk on a complex ecological subject only to have it concluded with a two-letter word. Think gradients rather than either/or.

The SERIALS listed include information on the relationships between herbivores on the same range. Some of these relationships may result in competitive advantages and disadvantages. Think gradients and relationships, synthesizing changing population densities and different amounts of overlap in the use of range resources to arrive at variable answers that are functions the competitive advantages and disadvantages.

REFERENCES, UNIT 1.2

COMPETITION BETWEEN HERBIVORES

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 relatns, utah	julander,o	1955
JRMGA	2---4	206	212	od--	lvstck wint forag stud,cal	dasmann,wp	1949
JWMAA	17--2	101	112	od--	dosh, competition in utah	smith,jg; julande	1953
JWMAA	39--4	813	813	od--	wnt field test,suppl blcks	anderson,rh; you/	1975
UAECA	121--	1	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
JWMAA	42--1	101	107	odvi	odhe,forag relns betwn,tex	krausman,pr	1978

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CGFPA	21---	1	20	odhe	doca, sagebr, use wint ran	anderson,ae	1969
HILGA	47--6	191	247	odhe	dosh, food relatns, califo	longhurst,wm; co/	1979
JRMGA	30--2	110	116	odhe	lvstck rel,ldgpl pine,oreg	stuth,jw; winward	1977
JWMAA	13--4	421	423	odhe	lvstck, eff on range, utah	smith,ad	1949
JWMAA	39--3	605	616	odhe	range rels, prairie habita	dusek,gl	1975
NAWTA	17---	448	458	odhe	doca, rumn cont, competitn	davis,rb	1952
WLMOA	20---	1	79	odhe	ceel, doca, rang ecol, rel	mackie,rj	1970

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
BICOB	3---1	23	32	ceel	lvstck range compet, calif	ciriacy-wantrup,/	1970
JRMGA	4---4	279	280	ceel	elk management problems	cooney,rf	1951
JRMGA	5---1	3	7	ceel	elk problems in montana	cooney,rf	1952
JWMAA	7---3	328	332	ceel	lvstck, compet summr range	pickford,gd; reid	1943
JWMAA	30--2	349	363	ceel	lvstck, range relatns, mon	stevens,dr	1966
NAWTA	14---	513	526	ceel	lvstck, rang carry-capacit	rasmussen,di	1949
NAWTA	25---	387	395	ceel	elk-cattle competitn prblm	jones,da	1960
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	40--1	151	162	rata	muskox-carib sum ran relat	wilkinson,pf; sha	1976

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JANSA	40--5	985	992	anam	antmop, 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 relationsh, n mex	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 range relatns	wilkinson,pf; sha	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	11	18	21	biga	lvstck, tech, study compet		1958
JRMGA	25--5	346	352	biga	dosh, guidelnes, graz,wint	jensen,ch; smith/	1972
JWMAA	21--1	101	103	----	interprt ovrbrws n e forst	webb,wl	1957
NAWTA	10---	251	256	biga	lvstck competitn, w ranges	stoddart,la; rasm	1945
XFRMA	4----	1	16	vert	habitat relations of verte	reynolds,hg; john	1964

OTHER PUBLICATIONS

Nelson, J. R., and D. G. Burnell. 1975. Elk-cattle competition in central Washington. p. 71-83. In Range Multiple Use Mgmt. Washington State University, Oregon State University, University of Idaho.

TOPIC 2. THE PROTECTIONIST APPROACH

This TOPIC is placed in the CHAPTER dealing with improper use because the protectionist approach can be carried too far. We usually don't think of hunting seasons as "protection," but that is precisely what they are. Hunting seasons are designed to protect the species when the animals are struggling with the effects of winter weather, when they are recovering from winter and are completing the final stages of gestation in the spring, and when the young are being raised in the summer. Further, the length of hunting seasons in the fall are based on population levels and hunter efficiency, as are bag limits.

A properly-regulated hunting season protects the population from over or under exploitation; that is a demonstrated fact. Whether you or I choose to hunt is a personal decision.

When does protection result in improper range use? When the amount of protection results in a net increase in biomass to the level at which the amount of forage required to support that biomass is greater than the amount of surplus forage available.

Too many hunters can reduce the deer population too much. Too many deer, which "hunt" plants, can reduce the plant population too much. Deer biologicst may be considered "friends of plants," just as many anti-hunters are members of "friends of animals." I even suggested that the Northeast Deer Study Group be renamed "Friends of Plants," but my motion was never seconded. The concept, however, is sound.

The effects of overpopulation of deer on plant production and succession are marked, as they can be for any species of wild ruminant that has reached high population densities. These effects are discussed in UNIT 2.1.

The effects of predator removal, which is being "friends of some but not all animals," are discussed in UNIT 2.2. This is one of the oldest "cure-alls" for arresting declines in game populations, but it is not the answer. Neither should we say that predators have no effects on populations; they do.

The effects of underharvesting are discussed in UNIT 2.3. This is probably one of the greatest potential problems that will result in improper range use as undue restrictions are placed on hunting in some areas and general interest in hunting declines with successive generations.

Trophy-hunting only, a challenging goal, may be self-defeating, as discussed in UNIT 2.4. All of these UNITS deal with gradients rather than either/or, all or none alternatives. Shift too much out of balance, improper range use results.

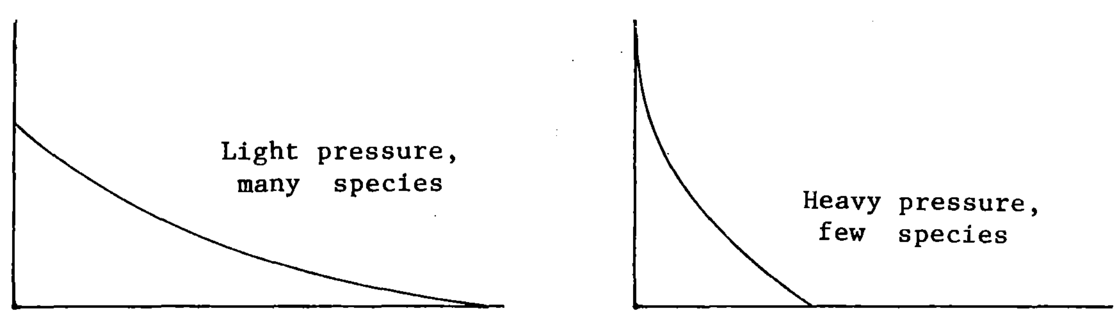
UNIT 2.1: EFFECTS ON PLANT COMMUNITIES

Wild ruminants do not select forage plants at random. There are some rather definitely-preferred species, and some rather definitely-avoided ones. The effect of this selection process is that some plants may be eaten so extensively that they disappear from the plant community and those that are avoided increase. The term applied to the former is "decreasers" and to the latter, "increasers."

Changes in plant community composition do not occur in a year or two, but over a period of years as a ruminant population builds up. During this time, the insiduous effects of grazing may go unnoticed to all but the trained biologist. Biologists, however, sometimes do not maintain continuous contact with the flora for enough years to observe the subtle changes. Changes in plant community composition become obvious only after the population of herbivores has exceeded appropriate levels.

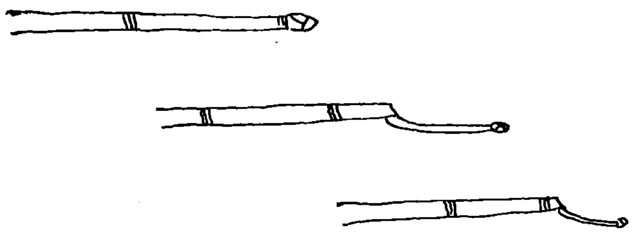
C. W. Severinghaus, recently retired after forty years of employment with the New York State Department of Environmental Conservation, states that white-tailed deer are one of, if not the prime determinant of forest stand composition in many areas of New York State. Species preferred by deer, such as white cedar, are gone in many areas because they simply cannot reproduce when exposed to the browsing pressure. Much less-preferred species, such as beech, reproduce and become relatively more abundant.

It appears that plant community diversity is a function of herbivore pressure. Communities free from grazing or browsing have many more species but fewer individuals of each. Communities subjected to heavy grazing or browsing pressure have many fewer species and many more individuals of the few species present. The relationships are illustrated below.

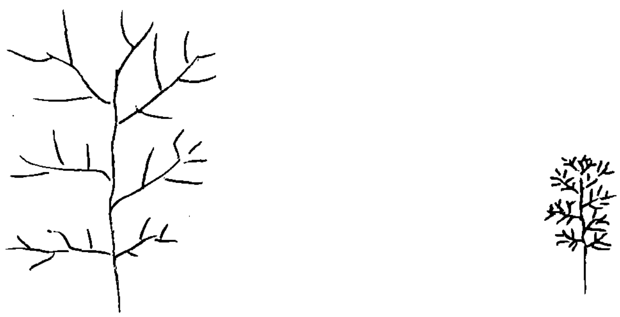


This relationship might be called the "gardening effect." A faithful gardener pulls the weeds but not the planted vegetables. The result? A few species in abundance, but little diversity. A poor gardener, not very enthusiastic about pulling weeds, lets them all grow. The result? A lot of species, but none that are overly abundant. Analogies are never perfect, but the idea applies in that the species that are left are the result of selection pressure.

Plant communities are organized collections of individuals. The effect of browsing on individual plants is illustrated below. Note that a little browsing may stimulate growth, but a lot of browsing depresses growth.



The whole plant, when overbrowsed, goes from a more open growth-form to a closed and compact one as illustrated in the drawing below.



Little growth occurs in the overbrowsed plant on the right; reserves do not build up enough nor is undisturbed growth allowed because frequent browsing removes meristimatic tissue.

Careful observations wil reveal the effects of excessive removal of plant material from individuals, species, and plant communities. These effects are much more common than is realized by the public, and sometimes more common than realized by biologists. It is hoped that this discussion will alert readers to be more observant and to help them identify these effects more readily in the field. The WORKSHEET at the end of this UNIT will also help.

REFERENCES, UNIT 2.1

EFFECTS ON PLANT COMMUNITIES

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	2---1	1	2	od--	prevntng deer concentratns	cox,wt	1938

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
AMNAA	31--3	697	743	odvi	range vege, livestock, tex	buechner,hk	1944
AUMGA	47--2	74	79	odvi	deer trouble, overpopulatn	cook,db	1945
JWMAA	21--1	101	103	odvi	interpret ovrbrws, n e for	webb,wl	1957
PCGFA	20---	15	18	odvi	forag analyse, mgt studies	short,hl	1966
PCGFA	21---	15	23	odvi	eff ovrpop, huntng,ft knox	dechert,ja	1967
WSCBA	2---9	3	9	odvi	to citizens of wisconsin	mackenzie,hw	1937
WSCBA	8---8	11	19	odvi	overuse, wint range, wisco	feeny,ws	1943
WSCBA	9---6	4	5	odvi	status, range, herd, wisco	feeny,ws	1944

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	11--2	162	177	odhe	odvi,survey, ovrpop ranges	leopold,a; sowls/	1947
JWMAA	36--2	571	578	odhe	shrub yield util, wint rng	anderson,ae; med/	1972
NAWTA	9----	167	172	odhe	murders creek herd, ovrpop	mitchell,ge	1944

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	8---1	1	6	ceel	od, results, overstocking	dalke,pd; spencer	1944
JWMAA	13--1	127	134	ceel	irruption of elk, manitoba	banfield,awf	1949

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

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

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
				oram			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
PNBAA	86...	25	....	many	graz mgt,sandhills prairie	sharpe,rs; bragg/	1976

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JOMAA	22--1	47	53	biga	criteria detrmn overbrwsng	swift,lw	1941
JWMAA	21--1	101	103	----	interprt ovrbrws n e fores	webb,wl	1957

CHAPTER 23,- WORKSHEET 2.1a

Plant morphology in relation to browsing

Refer to the sketches on page 22 for the general effect of browsing on plant growth and morphology. Then go into the field and find a shrub, sapling, or tree that has been browsed. Draw the browsed and unbrowsed twig patterns in the space below.

CHAPTER 23,- WORKSHEET 2.1b

Differences in the amount of growth in relation to browsing

The previous WORKSHEET dealt with morphology only. If you are able to find plants that have been browsed rather heavily, select a plant or part of a plant and complete one or more of the following measurements on individual twigs.

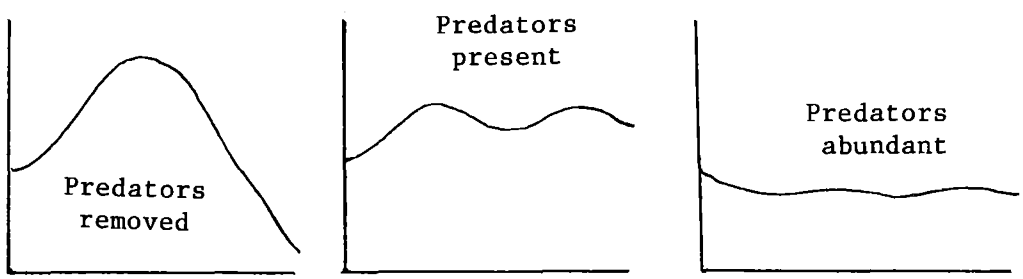
UNBROWSED			BROWSED		
LNGT	DIAM	WGHT	LNGT	DIAM	WGHT

UNBROWSED			BROWSED		
LNGT	DIAM	WGHT	LNGT	DIAM	WGHT

UNIT 2.2: EFFECTS OF PREDATOR REMOVAL

What does predator removal do to cause improper range use? Predation is one of many causes of mortality, and the removal of predators removes one cause of mortality. If other causes do not compensate, higher net population rates of increase result, and the potential for over-population and over-use of range resources exists. Populations of wild ruminants will grow beyond the capabilities of the range to support them, after which there will be a decline in the population, sometimes precipitously.

Just a ruminant populations cannot grow indefinitely because they are limited by the forage base, predator populations cannot grow indefinitely because they are limited by the prey base. Protection may result in initial population growth, but a leveling off and likely decline eventually occurs. Predator removal will not change the form of that relationships, only the shape. The potential effects are illustrated below.



It is hard to trust natural relationships sometimes, and we think the deer, the elk, the moose . . . need our help. Sometimes they do, but we must be careful about the extent to which we "help," and in no case should we enter into such management practices as predator removal without thorough analyses and simulations of the potential effects, not only on the prey population but on other ecological relationships as well.

REFERENCES, UNIT 2.2

EFFECTS OF PREDATOR REMOVAL

BOOKS

TYPE	PUBL	CITY	PGES	ANIM	KEY WORDS-----------------	AUTHORS/EDITORS--	YEAR
aubo	adwe	repa	48	----	biology of predatr control	howard,we	1974

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NAWTA	39---	230	240	odvi	intens shrt-trm pred remov	beasom,sl	1974
TWASA	35...	351	366	odvi	deer irruptions	leopold,a	1943

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
ECMOA	11...	229	265	odhe	biotic commmunitie, kaibab	rasmussen,di	1941

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
AUMGA	45--1	14	18	ceel	conservatn spiral, predatr	calahane,vh	1943
NAWTA	9---	173	176	ceel	our big game in winter	murie,oj	1944

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
MUZPA	25---	1	44	alal	the moose of isle royale	murie,a	1934
XNFSA	4----	1	202	alal	ecol, coyote, yellowstone	murie,a	1940

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NAWTA	6----	294	299	anam	predator control, wldl mgt	riter,we	1941
NAWTA	16---	179	190	anam	predator control, antl mgt	arrington,on; edw	1951

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
NAWTA	8----	329	331	biga	predtr contrl, probl areas	randle,ac	1943
QRBIA	21--2	144	177	vert	predation & vert populatns	errington,pl	1946
SCMOA	42...	444	456	----	malthusian princip in natr	mcatee,wl	1936

Other Publications

Udy, J. R. 1953. Effects of predator control on antelope populations. Utah Depart. Fish and Game, Salt Lake City, Utah. Pub. 5. 48 p.

CHAPTER 23, WORKSHEET 2.2a

Effects of predator removal on population growth

WORKSHEETS in PART VI, CHAPTER 19 listed various causes of mortality, and natality and mortality rates were used to determine "b" values for making exponential predictions of population growth.

Refer to those WORKSHEETS and redo the predictions given with variations in mortality rates due to predation, considering the compensatory effects from other causes of mortality. Evaluate the literature on predation (CHAPTER 5, UNIT 3.2) and try to develop some realistic predictions. If field data are not available, use an array of values to generate a family of answers for different combinations of predation and other causes of mortality.

UNIT 2.3: EFFECTS OF UNDERHARVESTING

The previous UNIT dealt with the effects of predator removal, which results in "underharvesting" by natural forces. Similar effects on populations result when underharvesting by hunting occurs; populations grow.

The basic difference between the effects of predator removal and the effects of underharvesting is that predation may occur throughout the year while "harvesting" or legal hunting occurs during only a small part of the year. Thus the standing crop is different through the year, depending on the timing of these sources of or lack of mortality.

Estimations of the effects of underharvesting are easily made with the procedures described in PART VI, CHAPTER 19, UNIT 1.4: EXPONENTIAL PREDICTIONS. Start with a cohort of 100, use a reasnoable weighted mean natality rate and a natural mortality with no hunting to determine a b value, and predict the population one year later. The resulting number, when divided by 100, gives the annual rate of increase as a rate. Add hunting mortality to illustrate the additive effects of hunting. Add hunting mortality and change other sources of mortality to illustrate the compensatory effects of hunting.

Note in the discussion of this method of predicting population in CHAPTER 19 that a 1:1 sex ratio is an underlying assumption in exponential predictions. If sex ratios are significantly different from 1:1, use the methods discussed in CHAPTER 19, UNIT 4.1: ARITHMETIC SUMMATIONS. The former is much quicker than the latter.

The eventual effects of underharvesting a wild ruminant population for several years in succession are declining body weights, body condition, and reproductive rates. Winter mortality will occur under some, perhaps even ordinary weather conditions, ast least in the young-of-the-year age class. The range, too, will change as ruminant populations increase; these effects were discussed in UNIT 2.1.

REFERENCES, UNIT 2.3*

EFFECTS OF UNDERHARVESTING

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

rata

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

anam

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

bibi

*Please check the SERIAL references listed at the ends of CHAPTERS 19 and 22 for references pertaining to EFFECTS OF UNDERHARVESTING.

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

CLOSING COMMENTS

I enjoy closing a "negative" chapter because I much prefer to direct my attention to positive things, to solutions rather than to problems. Nevertheless, the improper uses of the range that result from the circumstances described are important examples of management practices that should be avoided. Perhaps the one most important point to remember is that no particular management practice, once instituted, is good forever.

Aaron N. Moen
March 17, 1982

GLOSSARY OF SERIAL CODENS - CHAPTER TWENTY-THREE

Serials are identified by five-character, generally mnemonic codes called CODEN, listed in 1980 BIOSIS, LIST OF SERIALS (BioSciences Information Service, 2100 Arch Street, Philadelphia, PA 19103).

The headings for the lists of SERIALS are:

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

The volume and issue numbers (VO-NU) are given after the CODEN entry, followed by beginning page (BEPA), ending page (ENPA), species discussed (ANIM)1, KEY WORDS from the title, AUTHORS [truncated if necessary, slash (/) indicates additional authors], and YEAR.

AMFOA American Forests
AMNAA American Midland Naturalist
ANKIA Animal Kingdom, New York Zoological Society Bulletin
AUMGA Audubon Magazine

BICOB Biological Conservation

CGFPA Colorado Division of Game, Fish, and Parks Special Report (US)
CNSVA Conservationist

ECMOA Ecological Monographs (US)

FOSCA Forest Science (US)

HILGA Hilgardia

JANSA Journal of Animal Science (US)
JOMAA Journal of Mammalogy (US)
JRMGA Journal of Range Management (US)
JWMAA Journal of Wildlife Management (US)

MUZPA Miscellaneous Publications, Museum of Zoology, University of Michigan

NAWLA National Wildlife
NAWTA North American Wildlife and Natural Resources Conference, Transactions of the (US)
NEJZA Netherlands Journal of Zoology (Netherlands)
NZSTB New Zealand Journal of Science and Technology

PCGFA	Proceedings of the Southeastern Association of Game and Fish Commissioners (US)
PMASA	Proceedings of the Montana Academy of Sciences
PNBAA	Proceedings of the Nebraska Academy of Sciences and Affiliated Societies
QRBIA	Quarterly Review of Biology
SCAMA	Scientific American (US)
SCMOA	Scientific Monthly
* tdbca	Transactions of the Desert Bighorn Council
TRVIA	Terre Vie (La Terre et la Vie)
TWASA	Transactions Wisconsin Academy of Sciences, Arts, and Letters
UAECA	Utah Agricultural Experiment Station Circular
WLMOA	Wildlife Monographs (US)
WMBAA	Wildlife Management Bulletin (Ottowa) Series 1 (Canada)
WSCBA	Wisconsin Conservation Bulletin
XNFSA	U S National Park Service Fauna of the National Parks of the United States, Fauna Series
XFRMA	U S Forest Service Research Paper RM, (US)

*No BIOSIS CODEN

LIST OF PUBLISHERS - CHAPTER TWENTY-THREE

The headings for the lists of BOOKS are:

TYPE PUBL CITY PAGE ANIM KEY WORDS----------------- AUTHORS/EDITORS-- YEAR

All essential information for finding each book in the library is given on just one line. The TYPE of book could have either AUTHORS (aubo) or EDITORS (edbo). Publishers (PUBL) and CITY of publication are given with four-letter mnemonic symbols defined below. The PAGE column gives the number of pages in the book; ANIM refers to the species discussed in the book (given as a four-letter abbreviation of genus and species), and KEY WORDS listed are from the title. The AUTHORS/EDITORS and YEAR of publication are given in the last two columns.

adwe	Addison-Wesley	Reading, MA	rema
stac	The Stackpole Company	Harrisburg, PA	hapa
uwyp	University of Wyoming Press	Laramie, WY	lawy

GLOSSARY OF ANIMAL CODE NAMES

Wild ruminants are referred to in this CHAPTER by a 4-character abbreviation from the family, genus and genus-species. These are listed below under Abbreviation.

Scientific names of North American wild ruminants are those used in BIG GAME OF NORTH AMERICA, edited by J.C. Schmidt and D. L. Gilbert (1979: Stackpole Books, Harrisburg, PA 17105, 494 p.), and may be different from the scientific names given in the original literature.

The abbreviations used for North American wild ruminants are listed below.

CLASS: MAMMALIA

ORDER: ARTIODACTYLA	Abbreviation
FAMILY: CERVIDAE	cerv
GENUS: *Odocoileus* (deer)	od--
SPECIES: *O. virginianus* (white-tailed deer)	odvi
O. hemionus (mule deer)	odhe
GENUS: *Cervus* (Wapiti, elk)	ce--
SPECIES: *C. elaphus*	ceel
GENUS: *Alces* (moose)	
SPECIES: *A. alces*	alal
GENUS: *Rangifer* (caribou)	
SPECIES: *R. tarandus*	rata
FAMILY: ANTILOCAPRIDAE	
GENUS: *Antilocapra*	
SPECIES: *A. americana* (pronghorn)	anam
FAMILY: BOVIDAE	bovi
GENUS: *Bison* (bison)	bi--
SPECIES: *B. bison*	bibi
GENUS: *Ovis* (sheep)	ov--
SPECIES: *O. canadensis* (bighorn sheep)	ovca
O. dalli (Dall's sheep)	ovda
GENUS: *Ovibos*	
SPECIES: *O. moschatus* (muskox)	obmo
GENUS: *Oreamnos*	
SPECIES: *O. americanus* (mountain goat)	oram

The abbreviations used for European wild ruminants are listed below.

CLASS: MAMMALIA

ORDER: ARTIODACTYLA	Abbreviation
FAMILY: CERVIDAE	cerv
GENUS: *Capreolus* (roe deer)	ca--
SPECIES: *C. capreolus*	caca
GENUS: *Dama* (fallow deer)	da--
SPECIES: *D. dama*	dada
GENUS: *Cervus* (Wapiti, elk)	ce--
SPECIES: *C. elaphus* (red deer)	ceel
GENUS: *Alces* (moose)	
SPECIES: *A. alces*	alal
GENUS: *Rangifer* (caribou)	
SPECIES: *R. tarandus*	rata
FAMILY: BOVIDAE	
GENUS: *Bison* (bison)	
SPECIES: *B. bonasus*	bibo
GENUS: *Capra* (ibex, wild goat)	cp--
SPECIES: *C. aegargrus*(Persian ibex)	cpae
C. siberica (Siberian ibex)	cpsi

OTHERS

Abbreviations for a few other species and groups of species may appear in the reference lists. These are listed below.

Axis axis (axis deer)	axax
Elaphurus davidianus (Pere David's deer)	elda
Cervus nippon (Sika deer)	ceni
Hydropotes inermis (Chinese water deer)	hyin
Muntiacus reevesi (Chinese muntjac)	mure
Moschus moschifer (Chinese musk deer)	momo
Ovis nivicola (snow sheep)	ovni
Ovis musimon (moufflon)	ovmu
Ovis linnaeus (Iranian sheep)	ovli
Rupicapra rupicapra (chamois)	ruru
big game	biga
domestic sheep	dosh
domestic cattle	doca
domestic goat	dogo
domestic ruminant	doru
herbivore	hrbv
mammals	mamm
three or more species of wild ruminants	many
ruminants	rumi
ungulates	ungu
vertebrates	vert
wildlife	wldl
wild ruminant	wiru

JULIAN DAY: MONTH AND DAY EQUIVALENTS*

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Day
1	001	032	060	091	121	152	182	213	244	274	305	335	1
2	002	033	061	092	122	153	183	214	245	275	306	336	2
3	003	034	062	093	123	154	184	215	246	276	307	337	3
4	004	035	063	094	124	155	185	216	247	277	308	338	4
5	005	036	064	095	125	156	186	217	248	278	309	339	5
6	006	037	065	096	126	157	187	218	249	279	310	340	6
7	007	038	066	097	127	158	188	219	250	280	311	341	7
8	008	039	067	098	128	159	189	220	251	281	312	342	8
9	009	040	068	099	129	160	190	221	252	282	313	343	9
10	010	041	069	100	130	161	191	222	253	283	314	344	10
11	011	042	070	101	131	162	192	223	254	284	315	345	11
12	012	043	071	102	132	163	193	224	255	285	316	346	12
13	013	044	072	103	133	164	194	225	256	286	317	347	13
14	014	045	073	104	134	165	195	226	257	287	318	348	14
15	015	046	074	105	135	166	196	227	258	288	319	349	15
16	016	047	075	106	136	167	197	228	259	289	320	350	16
17	017	048	076	107	137	168	198	229	260	290	321	351	17
18	018	049	077	108	138	169	199	230	261	291	322	352	18
19	019	050	078	109	139	170	200	231	262	292	323	353	19
20	020	051	079	110	140	171	201	232	263	293	324	354	20
21	021	052	080	111	141	172	202	233	264	294	325	355	21
22	022	053	081	112	142	173	203	234	265	295	326	356	22
23	023	054	082	113	143	174	204	235	266	296	327	357	23
24	024	055	083	114	144	175	205	236	267	297	328	358	24
25	025	056	084	115	145	176	206	237	268	298	329	359	25
26	026	057	085	116	146	177	207	238	269	299	330	360	26
27	027	058	086	117	147	178	208	239	270	300	331	361	27
28	028	059	087	118	148	179	209	240	271	301	332	362	28
29	029	[060]	088	119	149	180	210	241	272	302	333	363	29
30	030		089	120	150	181	211	242	273	303	334	364	30
31	031		090		151		212	243		304		365	31

* For leap year, February 29 = JDAY 60. Add 1 to all subsequent JDAYs.

LIST OF WORKSHEETS - CHAPTER TWENTY-THREE

THE BIOLOGY AND MANAGEMENT OF WILD RUMINANTS

CHAPTER TWENTY-FOUR

SOCIOLOGICAL AND ECONOMIC CONSIDERATIONS

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

First printing, March 1982

Library of Congress Catalog Number 80-70984

CONTENTS OF CHAPTER TWENTY-FOUR

SOCIOLOGICAL AND ECONOMIC CONSIDERATIONS

CHAPTER 24. SOCIOLOGICAL AND ECONOMIC CONSIDERATIONS

The size, grace and beauty of wild ruminants make them very attractive animals. The sight of a deer grazing in a field, a mountain goat feeding on a rocky ledge, or a moose foraging on aquatics in a stream may well be the highlight of the day for a nature lover or camper. Photographing them is a satisfying experience for tourists and campers, even if they turn out to be little more than specks on a print or slide.

Deer fawns and the young of other wild ruminants are appealing baby animals. Conservation departments issue press releases each spring urging people not to pick up fawns, but finders are all too eager to believe that the fawn they happen to come across has been abandoned. People have an inner urge to help, forgetting that wild animals are not dependent on human care for their welfare.

Hunters enjoy the pursuit of well-adapted animals. Wild ruminants are well-adapted, and they are a most sought-after group of game species. Many state conservation departments are supported largely by the money from big game hunting license sales. Many hunters wait impatiently for the big game season, scheduling vacation time to enable them to return to the woods for the annual hunt.

The reactions of people to wild ruminants results in sociological and economic considerations that need to be given serious consideration by wildlife professionals. Each of these considerations warrants book-length discussions, which are beyond the pervue of this book and out of the areas of my main experiences as well. I include brief discussions here in CHAPTER 24 to call attention to the importance of sociological and economic considerations, and to provide a place to list references that are available on these subjects.

The two TOPICS (TOPIC 1: SOCIOLOGICAL CONSIDERATIONS and TOPIC 2: ECONOMIC CONSIDERATIONS) are divided into UNITS that represent major categories for consideration. The UNITS are broad categories. Recreation, for example, includes both consumptive and non-consumptive uses. The brief discussions of such major categories cannot be more that introductions to them. It is my hope that the reference lists will be useful to students and biologists, and that the lists will facilitate further considerations of these areas.

REFERENCES, CHAPTER 24

SOCIOLOGICAL AND ECONOMIC CONSIDERATIONS

BOOKS

TYPE	PUBL	CITY	PGES	ANIM	KEY WORDS-----------------	AUTHORS/EDITORS--	YEAR
edbo	babo	nyny	92	----	game ranching: ecol sensib	debell,g,ed	1970
aubo	dwfe	wadc	36	----	env conseq off-road vehicl	heath,r	1974
aubo	macm	nyny	280	----	the politics of extinction	regenstein,l	1975
edbo	laan	loen	335	----	lab animal handbook, vol 7	mcsheeny,t,ed	1976
aubo	wimi	wadc	40	----	f & w agencies, org, auth,		1977
aubo	psup	uppa	29	odvi	deer economics	pasto,jk; thomas,	1955
aubo	acpr	nyny	314	rata	hunters, archaelog studies	spiess,ae	1979
aubo	depc	nyny	367	wldl	man kind? our war on wldlf	amory,c	1975

TOPIC 1. SOCIOLOGICAL CONSIDERATIONS

The social relationships between wild ruminants and people may be divided into four areas of consideration. They are recreational (UNIT 1.1), political (UNIT 1.2), educational (UNIT 1.3), and legal considerations (UNIT 1.4).

Recreational considerations include outdoor activities, such as camping, fishing, hiking, skiing, and snowmobiling, and the viewing, photographing, and hunting of wild ruminants. These recreational pursuits are enjoyed by a large number of people on a regular basis, and by a much larger number on a casual basis.

Political considerations revolve around the use of wildlife resources in a democratic society, where ultimate decisions are made by a group of people who may express opinions, participate in open discussions, and cast ballots rather than by one person in a position of sole authority. The kinds of political considerations made are often dependent on the educational considerations given to wildlife resources.

Educational considerations include both formal and informal attempts to inform the public about wild ruminants and their management. These attempts focus on natural history, population dynamics, and the uses of wild ruminant resources. Educational methods used range from short educational messages in the media to graduate degrees in the field of wildlife management.

Legal considerations include not only the law enforcement necessary for the protection of species, but also questions of ownership and obligation. Since wild ruminants can be damaging to land, crops, and vehicles, questions of responsibility must be faced.

The four UNITS that follow provide some discussion and lists of references that will be useful in evaluating the roles of wild ruminants in society. These aspects of wild ruminant management have not received as much attention from biologists and natural resource specialists as they should have. Public emotions remain at higher levels than they ought to at times because both relationships between basic ecological principles and sociological considerations have not been given adequate thought by all concerned.

UNIT 1.1: RECREATIONAL CONSIDERATIONS

Recreational considerations may be divided into two major categories: consumptive and non-consumptive. The former is the traditional regulated use called hunting, participated in by both rural and urban residents, but especially by rural residents. The latter is, historically, a part of the life of the rural populace, who are close to wild populations of game. These two uses are presently areas of concern as centers of populations of both people and wild ruminants shift and values change.

The sport of hunting has been an accepted part of American life in the last few generations. When settlement was occurring, hunting was not sport but a matter of survival. As farms were established and crops and domestic animals became the major sources of food, hunting became a sport, with more regulations as hunting pressure increased. Hunting seasons have been established, and regulations govern the number of animals that may be taken without reducing long-term population productivity. In recent years, the sport of hunting has been challenged, especially on ethical and moral grounds, largely by urban and suburban residents.

As a biologist, I am aware of what happens to range conditions when populations of wild ruminants are not controlled. I also appreciate the concerns and understand the attitudes of non-hunters who are not aware of the ecological implications of resource inbalances. My personal view is that no one should be made to hunt, but neither should the privilege of hunting be denied to those that pursue it properly.

One problem that hunters are aware of and continually face is that a small percentage of hunters act irresponsibly, thereby giving hunters in general an undesirable image. Part of the problem results from within the hunting fraternity itself.

I was disheartened last fall when I read a story in an outdoor magazine about one hunter's experiences at a particular camp where he "got his first shot of straight whisky." When a major outdoor magazine perpetuates such images, it is no wonder that hunters are not held in high esteem. I do not care to be in the woods when persons who have had their first shot of straight whiskey (even if it was the night before) are in in the woods shooting lethal weapons any more than I care to be on the highway with such persons driving lethal weapons.

Another source of problems in the hunting:antihunting debate is in the term "sportsmen." I do not know where the term originated, but it is hard for the antihunter to appreciate "sportsmen" and "sport hunting" when the antihunter believes that hunting is immoral. Kicking the hide off a soccer ball may be sport, but it is hard to convince antihunters that the killing of a deer is in the same category. My recommendation is that the term "sportsmen" be deleted from professional use, and that we speak of "hunters," and "deer hunters," and "archery hunters" instead.

Many of us that hunt enjoy the time in the field more than the taking of an animal. Some of us enjoy being out so much we make the study of wildlife our profession. Many more hunters could and should spend more time in the field with cameras and binoculars. Many hunters form their opinions about the biology and management of wild ruminants from a couple of weekends or a week or two in the field each fall. I have personally found that inadequate, as I hope will be clear from the evidence in this 7-PART series.

Non-consumptive uses of wildlife have been gaining more attention in recent years, and for good reasons. Wildlife resources can be enjoyed by more people if opportunities are provided within appropriate ecological frameworks. Watching an animal may be thought of as harmless, but the accessibility to the animals and numbers of people involved can reach proportions that would cause damage to the habitats and stress to the animals at critical times of the year. The time when young are being reared is a sensitive time, and disturbances of wild, free-ranging animals should be kept to a minimum. Winter is a time of potential stress when the animals should be conserving energy, so disturbances should be kept to a minimum then too.

The rapid increase in snowmobile activities in the late 1960's and early 1970's posed a potential threat to wild ruminant populations. Previously inaccessible areas suddenly became vulnerable to high levels of human activity. Wintering areas could be reached and animals viewed without any malicious intent whatsoever, yet the animals would be disturbed at a time when their long-term adaptive strategy is one of metabolic depression and saving of energy (Moen 1978).

The beneficial effects of reduced activity by white-tailed deer in the winter are discussed in my paper on energy conservation in the winter (Moen 1976). Results of experiments on heart rate responses to snowmobile activities are discussed in Moen _et_ _al_. (1982). These experiments showed no evidence of habituation over the winter, and heart rate responses that peaked at over 2.5 times the pre-run or pre-stimulus rates. It is also of interest that these heart rate responses occurred when animals remained bedded as well as when they were up. Thus fright responses occurred without overt behavioral responses. Since I tend to be conservative in my approach to management, I suggest that recreational activities such as snowmobiling should be regulated to minimize disturbances of animals in wintering areas.

Enjoyable recreational opportunities stimulate interest in wild ruminants, and this should result in better understanding by the public of wild ruminant biology. The main problem facing the professional biologist is that the rate of increase of pressures and decision-making requirements exceeds the rate of increase in knowledge and understanding by the public.

The next UNIT (POLITICAL CONSIDERATIONS) includes discussions of some of the politics that are involved in wild ruminant management.

LITERATURE CITED

Moen, A. N. 1976. Energy conservation by white-tailed deer in the winter. Ecology: 57(1): 192-198.

Moen, A. N., S. Whittemore, and B. A. Buxton. 1982. Snowmobile effects on heart rates of captive white-tailed deer. New York Fish and Game Journal (In press).

REFERENCES, UNIT 1.1

RECREATIONAL CONSIDERATIONS

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	22--2	141	1483	od--	#s, kill, recre use, forst	burcalow,dw; mars	1958
NAWTA	38---	267	273	od--	factrs assoc attit hunting	applegate,je	1973
NVWLA	9---4	1	5	od--	nonresidnts, fish-gam prog	greenley,j	1964
WLSBA	3---1	3	6	od--	attit toward deer hunt, nj	applegate,je	1975

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	39--3	563	569	odvi	eff snowmobiles on wh-t de	dorrance,mj; sav/	1975
NFGJA	3---1	88	92	odvi	hunt accid, reln type hunt	severinghaus,cw;/	1956
PMACA	53---	51	72	odvi	attitudes landowners, deer	queal,lm	1968
RIJUA	30---	297	299	odvi	soc surv, attit towrd deer	mcneil,rj	1970
WSCBA	22--8	3	5	odvi	"tourist deer"	hovind,rb	1957

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
BICOB	3---1	23	32	ceel	tule elk, socio-econ study	ciriacy-wantrup,/	1970

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

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

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
tdbca	4----	47	48	ovca	esthetics of bghorn mngmnt	jones,fl	1960

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
MUOXD	15	44	52	many	churchil riv, conserv, rec	mondor,c; jurand,	1975

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JFUSA	44-11	902	906	biga	recr consid, west biga mgt	johnson,fw; rasmu	1946
JFUSA	45--5	323	328	biga	western public game fields	wagar,jvk	1947
NAWTA	14---	410	423	----	huntng stats, 1936 vs 1946	ludy,d	1949
NAWTA	14---	538	543	biga		mitchell,ge	1949
NAWTA	32---	89	94	game	public hunting opport, n y	swanson,ga; waldb	1967
NAWTA	34---	252	264	wldl	refuges, apprec vs consump	hendee,jc	1969
NAWTA	34---	283	293	----	econ eval recreat resource	______; bowden,gk	1969
NAWTA	38---	242	248	----	hunter behav, attit, philo	schole,bj; glove/	1973
NAWTA	39---	157	162	----	attit collg stud twrd hunt	shaw,d; gilbert,d	1974
PPPAA	1....	341	....	----	sci, mgt, soc-ecol realiti	obara,h; sibatani	1971
XBRPA	27---	1	76	----	1965 natl surv fish & hunt	us depar interior	1966
XFWCA	44---	1	50	----	natl surv hunting & fishng	us depar interior	1955
XFWCA	120--	1	73	----	natl surv hunting & fishng	us depar interior	1960

UNIT 1.2: POLITICAL CONSIDERATIONS

This UNIT on political considerations is directed toward public opinion and the political process. Ideally, a well-informed electorate results in the election of representatives capable of making the best decisions for all involved. Human characteristics and relationships do not result in the reaching of such ideals, however. There is no single best representative, just as there is no simple answer to complex questions.

Wildlife management in the United States is, hopefully, accomplished through political processes that are based on biological knowledge. Biologists have for years been calling for more inputs into political processes, and more control over the decisions made. There has been a general increase in the role of biologists in decision-making processes, but conflicts still arise and the biologists' views are not always held in high esteem.

The main factor that determines the roles and inputs of biologists in management decision-making processes is the legislative framework for making such decisions. In some states, the legislature passes the laws which govern season dates, lengths, bag limits, and other regulations. Biologists act in an advisory capacity only. Sometimes, biologists act in advisory capacities to special game commissions, wildlife management councils, or some other similar groups. Such groups may be elected or appointed.

Biologists have the most input into decision-making when their recommendations are accepted directly by a commissioner or legislature that has the authority to establish policy in the legal sense. In other words, the biologists make the biological decisions, and the appropriate person or body makes them legal.

There is no single best format for making and implementing management decisions. There are some that qualify for consideration as the "worst," and some that have been working effectively for many years. Sometimes political appointees have high levels of authority and very limited knowledge of natural resources generally and wild ruminants specifically. A political appointee in one state, holding the title of "commissioner," asked if "antlerless deer" was another species. As one biologist put it, "This is scary."

Political considerations seem to recur regularly in many states, increasing and decreasing with administrations and with natural conditions. Under some natural conditions, when productivity is high and mortality is low as a result of good weather and growing conditions, any reasonable system works. When natural conditions turn for the worst, it takes a well-designed political framework to allow biological truth to prevail over emotions or politics.

REFERENCES, UNIT 1.2

POLITICAL CONSIDERATIONS

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
PMACA	53---	51	72	odvi	attitudes landowners, deer	queal,lm	1968
RIJUA	30---	297	299	odvi	soc surv, attit towrd deer	mcneil,rj	1970
WSCBA	11--3	22	27	odvi	managing the public		1946

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
BICOB	3---1	23	32	ceel	tule elk, socio-econ study	ciriacy-wantrup,/	1970

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
UABPA	1....	11	14	rata	od, alask problm & prospct	hemming,je	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
tdbca	4----	28	34	ovca	dvlpng pblc spprt,mgt prgm	sizer,w	1960

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
MUOXD	15...	44	52	many	churchil riv, conserv, rec	mondor,c; jurand,	1975

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
NAWTA	5----	54	72	----	farmer-sportsman council?	chalk,jd; rasmus/	1940
NAWTA	10---	9	29	----	coop landownr-sprtsmn prgm	bromley,a	1945
PPPAA	1....	341	....	----	sci, mgt, soc-ecol realiti	obara,h; sibatani	1971

UNIT 1.3: EDUCATIONAL CONSIDERATIONS

Education, the solution to all of man's problems. True? False. As an educator, I know that statement is false for I see problems recurring regularly when their solutions are known, but not employed. Further, the human mind is not willing to employ correct solutions in many problem areas for we are greedy, selfish individualists intent on looking out for ourselves first.

Even if the above statement is an exaggeration, there will still be problems because the transmission of information is not an instantaneous process. It takes time for solutions to problems to reach those in a position to do something about them, and then it takes time to do something.

What can education accomplish in wild ruminant management? Education can change public attitudes. They can be changed faster today than at any time in history because mass media permits rapid transmission and thorough coverage of public audiences. The public can be "educated" and deliberately biased at the same time; a recent television program depicting hunting and hunters, produced with footage from a variety of sources and assembled in such a way that the truth was distorted, demonstrated that potential. Subsequent attempts to correct such distortions can never be totally successful.

The greatest responsibility that we educators have to our students is to help them think. I tell my students that if I do not help them learn to think, I leave them with nothing of lasting value. Numbers change (except for a few physical constants such as pi; 3.1416+) whenever new measurements are made. Some change more than others. Concepts, however, do not change, if they are correct.

The recognition of basic ecological concepts is critical when defining the framework within which ecological relationships occur and management decisions should be made. The number of concepts one has to deal with is less than expected when the basic components of the mutual world are recognized.

What are the basic components of the natural world? Matter and energy. Material resources and energy resources. Their relationships follow a few well-known laws.

Is the concept of chemical transformation of plant material to animal tissue different for different species? No. All species live within the law of transformation of energy, with less than 100% efficiency at each step from gross to net energy. Thus, there is but one concept, though there are many numbers representing different measured values of efficiencies. The numbers always vary from less than 1.0 to 0, however. Further, the ranges of values for given kinds of biological tissue fall into patterns; variability is not over the whole range of 1.0 to 0 when species of plants and animals that are interacting are involved.

Is the concept of thermal exchange different for different species? No. Thermal exchange involves only four modes of heat transfer, and all objects, dead or alive, exchange heat by these four modes. The importance of each of the four is dependent on circumstances, however.

Have not the two paragraphs above illustrated a simpler approach to the analyses of ecological relationships than is sometimes taken? Is it not possible that ecological analyses should begin with material and energy resources and the laws of matter and energy? Education then becomes a process of unfolding an information network around particular matter and energy resources. In this 7-PART series, the network includes wild ruminant and habitat resources. The information is presented--by discussions and direction--to other discussions in the literature. Some ecological relationships have been discussed and evaluated; many more could be but the printed pages are many as it is. At some point you, the reader, must assume the responsibility to educate yourself.

When I as a teacher have reached the point where students are capable of educating themselves, I have reached my ultimate goal. Is this not a worthy goal for all of us in wild ruminant biology?

REFERENCES, UNIT 1.3

EDUCATIONAL CONSIDERATIONS

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

rata

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

oram

UNIT 1.4: LEGAL CONSIDERATIONS

The initial title of this UNIT was "Law Enforcement." Legal concerns over wild ruminants, were, in the past, limited pretty much to law enforcement problems. I soon realized, however, that such a title was inadequate in view of court orders to prohibit hunting that have gained national attention in the last few years, as well as many other legal considerations that have arisen.

Legal considerations surrounding wildlife management and the management of wild ruminants are many. One, wildlife is the ward of the State, and state laws apply. Two, wildlife populations have, traditionally, been regulated by controlled hunting. Three, the game may be "owned" by the State but landowners have control over the use of their land by hunters. Four, anti-hunting groups have forced the courts of law into the management picture with cases testing the very legality of hunting. Five, questions over legal responsibilities extend to damage by wildlife and injuries to humans caused by wildlife. Six, larger questions are being raised concerning the roles of natural resources in relation to development as a result of the free enterprise system. Never in the history of the legal profession have there been so many opportunities to combine the practice of law with academic backgrounds in ecology.

This UNIT is not meant to be a definitive discourse on natural resource law. It does provide the opportunity to call to the attention of biologists the need for knowledge and understanding of biological processes so the right decisions are made in the first place, and legal tests of these decisions will not find them wanting.

I have held the belief for many years that my detailed research on white-tailed deer at Cornell University will have its most directly-useful application in the courts. Some day I will be called as an expert witness, and I will take not only the results of my own work but also of others with me (I'll have all 7 PARTS of the BIOLOGY AND MANAGEMENT OF WILD RUMINANTS close at hand). With such a body of evidence as several thousand references provide, I can clearly demonstrate that my testimony is not mere opinion. I wish to be prepared, and I continue to prepare myself, not specifically for a day in court, but because I enjoy learning more than any other activity, and someday that learning will be useful to others.

The students of today who are the biologists of tomorrow have unparalleled opportunities to delve into the inner working of natural systems. These opportunities come with the warning, however, that natural systems are so complicated, so complex that the human mind cannot completely comprehend them. We know only a little about a lot, and sometimes not enough. With diligent study and a group approach to these larger problems, we have opportunities to develop rational approaches to the management of wild ruminants. It may well be that a lawyer should be included in developing these approaches.

REFERENCES, UNIT 1.4

LEGAL CONSIDERATIONS

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NAWTA	15---	467	476	od--	precipitin test, enforcmnt	brohn,a; korschge	1950

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	29--3	471	486	odvi	estimat time of death, wtd	gill,jd; o'meara,	1965

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
				rata			

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
tdbca	3----	34	36	ovca	patrol,protection problems	wilbanks,jm	1959
tdbca	3----	37	40	ovca	patrol,prtctn prblms,calif	burandt,v	1959
tdbca	19---	21	23	ovca	army regulation 210-211	kelly,we	1966

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	20--2	169	172	many	identif, game, precip reac	keiss,rw; morriso	1956
JWMAA	34--4	917	921	many	id game meat, electrophore	dilworth,tg; mcke	1970

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	14--4	472	473	wldl	use helicopters, wldl work	buechner,hk	1950
JWMAA	34--4	917	921	game	tech ident meat game anims	dilworth,th; mcke	1970
TNWSD	27---	83	87	biga	viol simul, est illeg kill	vilkitis,jr; gile	1970

TOPIC 2. ECONOMIC CONSIDERATIONS

Economic considerations have always been part of evaluations of wildlife resources, but at no other time in the history of game management have they been more important than now, in the 1980's. Increasing pressures on all resources as a result of increasing human populations, coupled with a rapidly-rising rate of inflation, results in increased pressures on both resources and people. High meat prices, for example, result in more backyard deer hunters intent on getting venison at the least possible cost. This and other examples of resource use are discussed in UNIT 2.1.

Wildlife is managed for profit in some areas of the world and the United States. The enhancement of wildlife populations on lands leased to hunters is a form of husbandry in parts of the United States, even though the wildlife is not owned by the landowners. Interestingly, the bison, once almost extinct, is now part of cattle ranching operations as a result of a breakthrough in fertile offspring produced by bison-cattle crosses. These considerations are discussed in UNIT 2.2.

Reindeer herding is a very old husbandry practice by a specific group of people, the Lapps. It is discussed in UNIT 2.3, WILD RUMINANT HUSBANDRY, even though it is not part of North American wild ruminant ecology, because there are proposals to establish more ranchers and elk ranchers in North America.

An understanding of the economic factors affecting wild ruminants, as well as the economic value of ruminant populations, is important when making management decisions relative to wild, totally free-ranging populations or semi-domesticated ones.

REFERENCES, TOPIC 2

ECONOMIC CONSIDERATIONS

BOOKS

TYPE	PUBL	CITY	PGES	ANIM	KEY WORDS-----------------	AUTHORS/EDITORS--	YEAR
aubo	psup	uppa	29	odvi	deer economics	pasto,jk; thomas,	1955
edbo	babo	nyny	92	game	game ranching: ecol sensib	debell,g	1970
edbo	laan	loen	335	----	lab animal handbook, vol 7	mcsheeny,t	1976

UNIT 2.1: RESOURCE USE

Resource uses considered in this UNIT include not only the uses of wild ruminants for recreation, meat, and hides, but also uses of their habitat resources for various purposes. The former are the traditional uses, and the latter very recent ones of considerable concern.

The recreation and enjoyment provided by wild ruminants when they are viewed, photographed, and hunted is a very important part of the total recreation picture in the United States and Canada. The attention a moose gets when feeding in a stream by a road in Yellowstone or a herd of elk in a meadow in Rocky Mountain National Park results in cars stopped on both sides of the road and people scurrying to get pictures and closer views. Sometimes more excitement is generated than expected; bison in Yellowson have on occasion charged tourists, resulting in personal injuries. The recreational values of seeing wild ruminants in such natural habitats far outweigh the values of zoo-type displays or museums of mounted specimens, even though zoos and museums present well-designed displays in the limited space available.

Hunting provides much recreation and considerable meat each year. Years ago, when the human population was lower and more dispersed, hunters were also more dispersed. Now, the city-to-country emmigration on opening day in some states is of massive proportions, and steps are taken to distribute hunters and hunting pressure more evenly.

The meat and hide resources taken by hunters are considerable, and they are usually used to good advantage. Wild game supplements the main diet, and hides are used for leather goods. Horns and antlers are also often saved as trophies and mementos, and head mounts are made when appropriate.

Man also has need for resources which come from the earth, and some of our efforts to extract these resources are beneficial and some detrimental to wild ruminant habitats. Farm fields are good sources of food for deer, with heavy grazing in some hay fields and consumption of grains such as corn being an important part of winter diets in some areas. The deer compete with the farmer, but this is tolerated up to a point.

The use of space resources for oil pipelines in Alaska and Canada has caused considerable concern in recent years. The space occupied by pipelines is but a tiny fraction indeed, but the barriers pipelines may be to movements and migrations may be considerable. The effects of such human disturbances are discussed in CHAPTER 5, TOPIC 2, UNIT 2.4.

It is important to realize that space is a resource and the shared use of space by man and wild ruminants is detrimental to some wild ruminant species when man's activities are minimal, and detrimental to all wild ruminant species when man's activities are maximal. Even though wild ruminants may appear to tolerate fairly high levels of human activities in some situations, they are secretive and elusive animals, unable to accept and adapt to whatever man wishes to do without ultimate drops in productivity.

REFERENCES, UNIT 2.1

RESOURCE USE

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JAASA	46--3	159	....	odvi	tempor & spat subsist patt	curren,cb,jr	1975
PAABA	610--	1	33	odvi	costs and benefits of herd	thomas,dw; pasto,	1956

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
JFRBA	32--1	171	176	alal	impact dam, athabasc delta	townsend,gh	1975

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
ARANB	15--1	68	88	rata	econ uncertnty, rata eater	smith,jge	1978
BPURD	1----	1	4	rata	ceel, potl impct dev popul	klein,dr	1975
BPURD	1----	4	9	rata	the scandinavian viewpoint	villmo,l	1975
BPURD	1----	9	11	rata	canad carib & nrthrn devel	jakimchuk,rd	1975
EVCNA	3---3	218	224	rata	env probs assoc arctic dev	west,gc	1976

rata continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JAVMA	164-7	695	696	rata	anims, model human disease	dieterich,ra	1974
LIWIA	35---	20	24	rata	oil stalks the caribou	belous,r	1972
ORYXA	10--4	220	235	rata	oil and wildlife in alaska	scott,p	1970
SBHRA	7-1/2	20	40	rata	quant interactn man & anim	pelosse,jl	1972
TNWSD	31---	45	55	rata	rata, oil explor compatib?	miller,fl	1974
UABPA	1----	11	14	rata	od, alask, problm & prospc	hemming,je	1975

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
HILGA	19--8	265	284	anam	od, food valu meat, factrs	cook,bb; witham,/	1949
JANSA	45--6	1477	1482	anam	ceel, use range futur meat	cook,cw	1977

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
AIWHA	14-12	534	540	ov--	goat, sheep, orig domestic	kyle,r	1972

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
BICOB	5---3	191	195	ovca	mined land reclam, alberta	etter,hm	1973
tdbca	13---	98	102	ovca	expenditurs, hunting,idaho	spillett,jj; morg	1969

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
ATICA	30--3	135	154	obmo	& man, cent canad sub-arct	burch,es,jr	1977
ATICA	30--4	246	....	obmo	& man in subarctc, archael	gordon,bc	1977
INWLA	2---5	12	15	obmo	musk-ox - it fed cave man	scott,jd	1972

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JANSA	40--5	1016	1019	many	potential as protein sourc	novakowski,ns; so	1975
MUOXD	15...	10	29	many	evol lndscap churchill riv	kupsch,wo	1975
VEZOA	1....	74	78	many	faun, age peat bog, archae	pidoplichko,ig; i	1975

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
ATRLA	12--5	67	79	bibo	cross wisent & domest catt	krasinska,m	1967

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
BICOB	6---4	274	284	wldl	sagebrush conversn projcts	vale,tr	____
BINPA	14	73	82	wldl	conseqs hydro elec projcts	gill,d	1978
BISNA	26	754	760	wldl	cons nat ecosys, fossil en	bormann,fh	1976
CEXBI	916--	1	36	wldl	econ impct, hunt, fish exp	rohdy,dd; lovegro	1970
JANSA	40--5	1009	1015	wldl	use wild & dom anim, genet	spillett,jj; bun/	1975
JRMGA	8---5	214	217	biga	biga & commerc meat consum	lloyd,rd	1955
JRMGA	10--2	67	70	biga	econ aspct lvstck-biga rel	kimball,tl	1957
JWIDA	6---4	397	401	wldl	use of to monitor zoonoses	trainer,do	1970
JWMAA	43--3	642	649	wldl	eval habitat, right-of-way	bramble,wc; byrne	1979
NAWTA	27---	255	267	wldl	econ aspct of on priv land	bolle,aw; taber,r	1962

wldl continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NAWTA	36---	428	438	wldl	communicatng values, kenai	steinhoff,hw	1971
NAWTA	39---	483	485	wldl	env eff surf min, need mgt	platts,ws	1974
PHSCA	23--1	1	14	wldl	contrib econ to valu theor	boulding,ke	1956
QBMAA	44--4	697	713	anim	powr line rght-of-way, use	gysel,lw	1962
UABPA	1----	1	33	wldl	wldlf in economy of alaska	buckley,jl	1957
UTSCB	23--1	16	....	wldl	wldl - a community resourc	berryman,jh	1962
WRNDA	12...	413	451	rumi	role, rumi, world food sup	cuthbertson,dp	1970
XAPRA	177--	1	14	wldl	wood plnt trial, mine recl	howard,gs; rauzi/	1979
XFWLA	246--	1	5	game	save meat - it is valuable	rasmussen,di	1943
XFWWA	98---	1	16	wldl	wld animals as source food	talbot,lm	1966
ZEJAA	24--2	72	88	wldl	mode prot fr constrc canal	schneider,e; woel	1978

UNIT 2.2: MANAGING WILDLIFE HABITATS FOR PROFIT

Wildlife habitats may be managed for profit even though the wild animals using the habitats are under the jurisdiction of the state or province. Landowners have the privilege of controlling access to their land, and if fees are charged for the use of the land for hunting, the profit-motive may be realized.

Charging for use of land brings about certain expectations by the user and legal responsibilities on the landowner. Users expect to be charged reasonable rates in relation to the likelihood of success, and that likelihood must be reasonably high before such an enterprise will be successful.

Small farms are not well-suited to paid-hunting because the resident population of deer or other species is too low, and the animals are too wide-ranging. A group of small farms may be feasible; cooperative agreements may be arranged that involve several landowners.

Large ranches are more suited to paid hunting than small farms. Landowners in Texas and other western states provide more opportunities for commercialized hunting than landowners in the eastern states do. Hunting fees vary greatly, of course. Rates may be levied on a per day basis, on a success basis, or a combination of both.

Landowners who are collecting fees for use of their land must provide control over access in order to be fair to those paying. Reasonable precautions must also be taken in order to avoid problems that could be blamed on negligence. Liability insurance is a very wise investment for such operations.

Hunting in North America has been much less commercialized than in Europe, and a larger spectrum of the citizenry participates in hunting. In the United States and Canada, hunting has not been an activity of the rich, elite, or fortunate few. This will change, but I have no idea how fast changes will occur. One thing is certain; changes will run in the direction of more controlled access to private land rather than less access as human populations increase, wild ruminant populations decrease, and resource uses become more competitive.

REFERENCES, UNIT 2.2

MANAGING WILDLIFE HABITATS FOR PROFIT

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
AKASA	2----	65	68	od--	econ imprtnc, arkansas dee	wood,r	1947
JRMGA	18--5	247	250	od--	potnl retrn deer vs lvstck	ramsey,cw	1965

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
				rata			

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
				oram			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JANSA	40--5	1000	1008	game	commer use game anim, rnge	teer,jg	
JANSA	40--5	1016	1019	wldl	potential as protein sourc	novakowski,ns; so	1975
JANSA	45--6	1477	1482	ceel	anam, rangeland, meat prod	cook,cw	1977
NAWTA	33---	192	204	game	bionom, ethic implic, harv	teer,jg; forrest,	1968
OOKHA	9----	26	28	ungu	[prospects for econom use]	bannikov,a	1964

UNIT 2.3: WILD RUMINANT HUSBANDRY

Wild ruminant husbandry is the term applied when the animals rather than their habitats are managed, or raised with some control over their distribution through the year, and harvested rather selectively and heavily in the fall.

Wild ruminants have not been "farmed" or "ranched" in North America except in a few instances. The most economically important use of a wild ruminant in ranching may well be the crossing of bison and cattle. A major breakthrough occurred in 1960 when fertile offspring were produced from bison cattle crosses, resulting in the "beefalo" breed. This breed is 3/8 bison, 3/8 charalois, and 1/4 herford. Advertisements for beefalo stock appear regularly in farm magazines.

Buffalo ranches are also found in many states, from the west to the east coast. These ranchers raise bison from native stock obtained from surplus animals removed from wild or semi-wild herds in the western states. Buffalo ranchers must have strong, high fences. Wire netting up to six feet high is desirable as bison are not nearly as docile as domestic cattle.

Proposals for deer, elk, and moose farms recur with different modes of operation. Some would combine the tourist industry with meat production, and others would be strictly for meat production. Such endeavors could be successful, but raising wild ruminants should not be thought of as a slightly-modified cattle or sheep operation. Wild ruminants do have some unique characteristics, and there are technical problems that need to be solved.

Just as bison reached very low numbers and have since recovered, both in the wild and in semi-wild herds, muskox are also being raised in confinement.

Reindeer husbandry is a very old practice in the Scandanavian countries and in Russia. The migratory Lapps have tended herds for centuries, living very much the same way that their ancestors did until the last few years, when marked changes have taken place. Reindeer are slaughtered for meat and hides, and recently, antler velvet has been commanding high prices as an export to Asian countries where it is processed for sale as an aphrodisiac. The last practice has caused some concerns and raised questions in the reindeer industry.

Mechanization has caused marked changes in reindeer operations. The snowsled, or snowmobile, has had the greatest impact as it has greatly increased the mobility of the herders. Increased communication capabilities and the need for education has also changed the life-style of the nomadic Lapps, with less tendency for family units to move, resulting in a more settled existence. The reindeer must be moved, however, for winter and summer pastures are easily overgrazed.

There are many references to reindeer husbandry in the literature where a more complete picture of approaches to the husbandry of wild ruminants may be gained. There is, perhaps, not only room for both wild and semi-wild herds of our present wild ruminants but some good reasons why both should be part of the wild ruminant picture in the years ahead.

REFERENCES, UNIT 2.3

WILD RUMINANT HUSBANDRY

BOOKS

TYPE	PUBL	CITY	PGES	ANIM	KEY WORDS-----------------	AUTHORS/EDITORS--	YEAR
aubo	hutc	loen	....	----	a history of domestic anim	zeuner,fe	1963
edbo	alpc	chil	....	----	domest,exploitn plnt, anim	ucko,pj; dimbleby	1969
aubo	cfst	spva	....	rata	reindeer husbandry, 2nd ed	zhigunov,ps	1961
aubo	usdi	juak	....	rata	reind hust, ecolog princip	sjenneberg,s; sla	1979
aubo	nyzs	nyny	254	bibi	the american bison	garretson,	1938
aubo	haho	nyny	85	obmo	oomingmak,nunivak is, alas	matthiessen,p	1967

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
ORYXA	7----	301	304	alal	domestc, russian natl park	yazan,y; knorre,y	1964

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
ANHUA	35--8	12	12	rata	barley sprts, suppl, alask	anonymous	1980
ATICA	3....	27	44	rata	reindeer industry, alaska	lantis,m	1950
FDSRA	22...	1	8	rata	introduced reinde, georgia	bonner,wn	1958
FENNA	95--4	1	61	rata	reindeer husbandry, finlnd	helle,r	1967
FMFUB	7---4	393	398	rata	human fright cries, acoust	pelosse,jl	1974
GEORA	49...	76	94	rata	arctic reindeer industry	sonnenfeld,j	1959
IUCSB	16...	159	169	rata	obmo, husbandr as land use	scotter,gw	1970
JOMAA	49...	....	....	rata	dev of reind husb in canad	treude,e	1968
JRMGA	5---4	243	251	rata	dev reind indust in alaska	hanson,hc	1952
JRMGA	18...	301	305	rata	reinde ranchng, fennoscand	scotter,gw	1965
JRMGA	25--3	167	174	rata	reindeer ranching in canad	scotter,gw	1972
NAWTA	1----	424	427	rata	canada's reinde experiment	bonnycastle,rhg	1936
OOKHA	2....	27	28	rata	return the reindeer to our	michurin,l	1963
ORYXA	11--4	268	269	rata	finland's reindeer	montonen,m	1972
PRIRA	1....	120	....	rata	wild reindeer of sakhalin	mishin,ip	1952
UABPA	8....	1	82	rata	reindee ecol, mngmnt, swed	skuncke,f	1969
XAMPA	207--	1	40	rata	raising reindeer in alaska	palmer,lj	1934
ZETIA	32--2	199	208	rata	anim acoustic signa, human	pelosse,jl	1973
ZHIVA	1954.	62	68	rata	organization of food basis	ustinov,vi; pokr/	1954
ZOGAA	33...	55	64	rata	contribution to the mainta	seitz,a	1966
ZOLZA	45--4	599	608	rata	wld rein,basin,pyasina riv	krechmar,av	1966

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CNJNA	38--1	87	90	bibi	x doca, feedlot study, clv	peters,hf	1958
CNJNA	46...	157	164	bibi	x doca, range calf product	peters,hf; slen,s	1966
CNJNA	56...	489	496	bibi	x doca, pre-,pstwen wt, cv	lawson,je; keller	1976
CNJNA	58--4	537	545	bibi	x doca, influ bisn %, wean	keller,dg; lawson	1978

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
IUCSB	24--2	909	920	obmo	behavior and domestication	wilkinson,pf	1974
IZYBA	5----	58	65	obmo	herd of musk-oxn in captiv	oeming,a	1965
NGGMA	137..	862	79	obmo	domestictng wild and wooly	teal,jj,jr	1970

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
ATRLA	12...	385	389	bibo	doca, studies on hybridztn	krasinska,m; puce	1968

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
FAFLB	13...	19	23	game	game on farms	kettlitz,wk	1962
IUCSB	9----	113	119	vert	biol eff,non-nativ environ	de vos,a; petride	1967
IUCSB	24--1	14	55	ungu	mother-infant relationshps	lent,pc	1974
IUCSB	24--2	530	541	ungu	mgt hrds, rel to domestica	baskin,lm	1974
IUCSB	24--2	603	617	ungu	behav problm, captiv,domes	kiley,m	1974
IUCSB	24--2	830	852	ungu	behav,hsbndry,s afric rnch	bigalke,rc	1974
IUCSB	24--2	882	887	game	dvlpmnt,s africn game rnch	deane,nn; feely,j	1974
IUCSB	24--2	888	892	wldl	hsbndr,rhodesian game rnch	johnstone,pa	1974
IUCSB	24--2	893	899	game	game ranching in texas	teer,jg	1974

OTHER PUBLICATIONS

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

Deakin, A., G. W. Muir and A. G. Smith. 1935. Hybridization of domestic cattle, bison and yak. Canadian Dept, Agric. Tech. Bull, no. 2. 30 p.

Kerr, M. A., V. J. Wilson and H. H. Roth. 1970. Studies on the agricultural utilization of semi-domesticated eland (Taurotragus oryx) in Rhodesia, 2. Feeding habits and food preferences. Rhodesian J. Agric. Res. 8:71-77.

Knorre, P. 1961. The results and perspectives of domestication of moose. Trudy Pechoro-Illychskovo Gos. Zapovednika, no. 9. Komi ASSR Pub. 263 p.

Knorre, P. 1961. The results and perspectives of the domestication of the moose. Translation from the Russian in the Can. Wildl. Serv. Library, Ottawa. Papers of the Pechora-Ilych State Reservation 9:5-177.

Leeds, A. 1965. Reindeer herding and Chukchi social institutions. In Man, culture, and animals. eds. A. Leeds and A. P. Vayda, pp. 87-128, Amer. Assoc. for the Advancement of Sci. Washington, D.C.

Posselt, J. 1963. The domestication of the eland. Rhodesian J. Agric. Res. 1(2):81-87.

Skinner, J. D. 1967. An appraisal of the eland as a farm animal in Africa. Anim. Breeding Abstrs. 25(2):177-186.

Teal, J. J., Jr. 1958. Golden fleece of the Arctic. The Atlantic 201:76-81.

Teal, J. J., Jr. 1970. Operation musk ox 1969. Amer. Scandinavian Rev. 58:11-23.

Zhigunov, P. S., ed. 1961. Reindeer husbandry. English translation, 1968, U. S. Dept. of Commerce, Clearinghouse for Federal Scientific & Tech. Information, Springfield, Va.

CLOSING COMMENTS

This CHAPTER has been a departure from biology, but is nevertheless an important part of management decision-making. It's importance is greater than both the number of pages devoted to it and the number of references available in the literature. Expansions of these considerations will be made as the ecological framework becomes both more complete and more computerized, with social and economic subroutines inserted at the appropriate place and time in the computing cycles. This one area of needed research is discussed in the next CHAPTER on RESEARCH NEEDS, along with evaluations of the present status of knowledge.

A. N. Moen
March 8, 1982

GLOSSARY OF SERIAL CODENS - CHAPTER TWENTY-FOUR

Serials are identified by five-character, generally mnemonic codes called CODEN, listed in 1980 BIOSIS, LIST OF SERIALS (BioSciences Information Service, 2100 Arch Street, Philadelphia, PA 19103).

The headings for the lists of SERIALS are:

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

The volume and issue numbers (VO-NU) are given after the CODEN entry, followed by beginning page (BEPA), ending page (ENPA), species discussed (ANIM)1, KEY WORDS from the title, AUTHORS [truncated if necessary, slash (/) indicates additional authors], and YEAR.

AIWHA Animals (London)
AKASA Arkansas Academy of Science Proceedings
ANHUA Animal Nutrition and Health
ARANB Arctic Anthropology
ATICA Arctic (Canada)
ATRLA Acta Theriologica (Poland)

BICOB Biological Conservation
BINPA Boreal Institute for Northern Studies, University of Alberta Occasional Publication
BISNA Bioscience
BPURD Biological Papers of the University of Alaska Special Report

CEXBI see CEXSB
CEXSB Colorado State University Experiment Station Bulletin

EVCNA Environmental Conservation

FAFLB Fauna and Flora (Transvaal)
FDSRA Falkland Islands Dependencies Survey Scientific Reports
FENNA Fennia
FMFUB Forma et Functio (West Germany)

GEORA Geographic Review

HILGA Hilgardia

INWLA International Wildlife
IUCSB International Union for Conservation of Nature and Natural Resources Publications New Series
IZYBA International Zoo Year Book

JAASA Journal of the Alabama Academy of Science
JANSA Journal of Animal Science (US)
JAVMA Journal of the American Veterinary Medical Association (US)
JFRBA Journal of the Fisheries Research Board of Canada
JFUSA Journal of Forestry (US)
JOMAA Journal of Mammalogy (US)
JRMGA Journal of Range Management (US)
JWIDA Journal of Wildlife Diseases (US)
JWMAA Journal of Wildlife Management (US)

LIWIA Living Wilderness

MUOXD Musk-ox

NAWTA North American Wildlife and Natural Resources Conference,
Transactions of the (US)
NFGJA New York Fish and Game Journal (US)
NGGMA National Geographic Magazine
NVWLA Nevada Wildlife

OOKHA Okhota i Okhotnich'e Khozyaistvo
ORYXA Oryx

PAABA Pennsylvania Agricultural Experiment Station Bulletin
PHSCA Philosophy of Science
PMACA Papers of the Michigan Academy of Sciences, Arts and Letters
PPPAA Pacific Science Congress Proceedings
PRIRA Priroda (Moscow)

QBMAA Michigan Agricultural Experiment Station, Quarterly Bulletin

RIJUA Riistatieteellisia Julkaisuja (Finnish Game Research)

SBHRA

tdbca Transactions of the Desert Bighorn Council
TNWSD Transactions of the Northeast Section, The Wildlife Society

UABPA	Biological Papers of the University of Alaska
UTSCB	Utah Science (US)
VEZOA	Vestnik Zoologii
WLSBA	Wildlife Society Bulletin
WRNDA	World Review of Nutrition and Dietetics
WSCBA	Wisconsin Conservation Bulletin
XAMPA	U S D A Miscellaneous Publication
XAPRA	U S D A Production Research Report
XBRPA	U S Bureau of Sport Fisheries and Wildlife Resource Publication
XFWCA	U S Fish and Wildlife Service Circular
XFWLA	U S D I Fish and Wildlife Service, Wildlife Leaflet
XFWWA	U S Fish and Wildlife Service Special Scientific Report - Wildlife
ZEJAA	Zeitschrift fuer Jagdwissenschaft
ZETIA	Zeitschrift fuer Tierpsychologie
ZHIVA	Zhivotnovodstvo
ZOGAA	Zoologische Garten
ZOLZA	Zoologicheskii Zhurnal (USSR)

LIST OF PUBLISHERS - CHAPTER TWENTY-FOUR

The headings for the lists of BOOKS are:

TYPE PUBL CITY PAGE ANIM KEY WORDS------------------ AUTHORS/EDITORS-- YEAR

All essential information for finding each book in the library is given on just one line. The TYPE of book could have either AUTHORS (aubo) or EDITORS (edbo). Publishers (PUBL) and CITY of publication are given with four-letter mnemonic symbols defined below. The PAGE column gives the number of pages in the book; ANIM refers to the species discussed in the book (given as a four-letter abbreviation of genus and species), and KEY WORDS listed are from the title. The AUTHORS/EDITORS and YEAR of publication are given in the last two columns.

acpr	Academic Press	New York, NY	nyny
alpc	Aldine Publishing Company	Chicago, IL	chil
babo	Ballentine Books	New York, NY	nyny
cfst	Clearinghouse for Fed. Sci. & Tech. Info., U. S. Dept. Commerce	Springfield, VA	spva
depc	Dell Publishing Co.	New York, NY	nyny
dwfe	Defenders of Wildlife and Friends of the Earth	Washington, DC	wadc
haho	Hastings House Publishers	New York, NY	nyny
hutc	Hutchinson	London, England	loen
laan	Laboratory Animals Ltd.	London, England	loen
macm	Macmillan Co.	New York, NY	nyny
nyzs	New York Zoological Society	New York, NY	nyny
psup	Pennsylvania State University Press	University Park, PA	uppa
usdi	U. S. Dept. Interior	Juneau, AK	juak
wimi	Wildlife Management Institute	Washington, DC	wadc

GLOSSARY OF ANIMAL CODE NAMES

Wild ruminants are referred to in this CHAPTER by a 4-character abbreviation from the family, genus and genus-species. These are listed below under Abbreviation.

Scientific names of North American wild ruminants are those used in BIG GAME OF NORTH AMERICA, edited by J.C. Schmidt and D. L. Gilbert (1979: Stackpole Books, Harrisburg, PA 17105, 494 p.), and may be different from the scientific names given in the original literature.

The abbreviations used for North American wild ruminants are listed below.

CLASS: MAMMALIA

ORDER: ARTIODACTYLA	Abbreviation
FAMILY: CERVIDAE	cerv
GENUS: *Odocoileus* (deer)	od--
SPECIES: *O. virginianus* (white-tailed deer)	odvi
O. hemionus (mule deer)	odhe
GENUS: *Cervus* (Wapiti, elk)	ce--
SPECIES: *C. elaphus*	ceel
GENUS: *Alces* (moose)	
SPECIES: *A. alces*	alal
GENUS: *Rangifer* (caribou)	
SPECIES: *R. tarandus*	rata
FAMILY: ANTILOCAPRIDAE	
GENUS: *Antilocapra*	
SPECIES: *A. americana* (pronghorn)	anam
FAMILY: BOVIDAE	bovi
GENUS: *Bison* (bison)	bi--
SPECIES: *B. bison*	bibi
GENUS: *Ovis* (sheep)	ov--
SPECIES: *O. canadensis* (bighorn sheep)	ovca
O. dalli (Dall's sheep)	ovda
GENUS: *Ovibos*	
SPECIES: *O. moschatus* (muskox)	obmo
GENUS: *Oreamnos*	
SPECIES: *O. americanus* (mountain goat)	oram

The abbreviations used for European wild ruminants are listed below.

CLASS: MAMMALIA

ORDER: ARTIODACTYLA	Abbreviation
FAMILY: CERVIDAE	cerv
GENUS: *Capreolus* (roe deer)	ca--
SPECIES: *C. capreolus*	caca
GENUS: *Dama* (fallow deer)	da--
SPECIES: *D. dama*	dada
GENUS: *Cervus* (Wapiti, elk)	ce--
SPECIES: *C. elaphus* (red deer)	ceel
GENUS: *Alces* (moose)	
SPECIES: *A. alces*	alal
GENUS: *Rangifer* (caribou)	
SPECIES: *R. tarandus*	rata
FAMILY: BOVIDAE	
GENUS: *Bison* (bison)	
SPECIES: *B. bonasus*	bibo
GENUS: *Capra* (ibex, wild goat)	cp--
SPECIES: *C. aegargrus*(Persian ibex)	cpae
C. siberica (Siberian ibex)	cpsi

OTHERS

Abbreviations for a few other species and groups of species may appear in the reference lists. These are listed below.

Axis axis (axis deer)	axax
Elaphurus davidianus (Pere David's deer)	elda
Cervus nippon (Sika deer)	ceni
Hydropotes inermis (Chinese water deer)	hyin
Muntiacus reevesi (Chinese muntjac)	mure
Moschus moschifer (Chinese musk deer)	momo
Ovis nivicola (snow sheep)	ovni
Ovis musimon (moufflon)	ovmu
Ovis linnaeus (Iranian sheep)	ovli
Rupicapra rupicapra (chamois)	ruru
big game	biga
domestic sheep	dosh
domestic cattle	doca
domestic goat	dogo
domestic ruminant	doru
herbivore	hrbv
mammals	mamm
three or more species of wild ruminants	many
ruminants	rumi
ungulates	ungu
vertebrates	vert
wildlife	wldl
wild ruminant	wiru

JULIAN DAY: MONTH AND DAY EQUIVALENTS*

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Day
1	001	032	060	091	121	152	182	213	244	274	305	335	1
2	002	033	061	092	122	153	183	214	245	275	306	336	2
3	003	034	062	093	123	154	184	215	246	276	307	337	3
4	004	035	063	094	124	155	185	216	247	277	308	338	4
5	005	036	064	095	125	156	186	217	248	278	309	339	5
6	006	037	065	096	126	157	187	218	249	279	310	340	6
7	007	038	066	097	127	158	188	219	250	280	311	341	7
8	008	039	067	098	128	159	189	220	251	281	312	342	8
9	009	040	068	099	129	160	190	221	252	282	313	343	9
10	010	041	069	100	130	161	191	222	253	283	314	344	10
11	011	042	070	101	131	162	192	223	254	284	315	345	11
12	012	043	071	102	132	163	193	224	255	285	316	346	12
13	013	044	072	103	133	164	194	225	256	286	317	347	13
14	014	045	073	104	134	165	195	226	257	287	318	348	14
15	015	046	074	105	135	166	196	227	258	288	319	349	15
16	016	047	075	106	136	167	197	228	259	289	320	350	16
17	017	048	076	107	137	168	198	229	260	290	321	351	17
18	018	049	077	108	138	169	199	230	261	291	322	352	18
19	019	050	078	109	139	170	200	231	262	292	323	353	19
20	020	051	079	110	140	171	201	232	263	293	324	354	20
21	021	052	080	111	141	172	202	233	264	294	325	355	21
22	022	053	081	112	142	173	203	234	265	295	326	356	22
23	023	054	082	113	143	174	204	235	266	296	327	357	23
24	024	055	083	114	144	175	205	236	267	297	328	358	24
25	025	056	084	115	145	176	206	237	268	298	329	359	25
26	026	057	085	116	146	177	207	238	269	299	330	360	26
27	027	058	086	117	147	178	208	239	270	300	331	361	27
28	028	059	087	118	148	179	209	240	271	301	332	362	28
29	029	[060]	088	119	149	180	210	241	272	302	333	363	29
30	030		089	120	150	181	211	242	273	303	334	364	30
31	031		090		151		212	243		304		365	31

* For leap year, February 29 = JDAY 60. Add 1 to all subsequent JDAYs.

THE BIOLOGY AND MANAGEMENT OF WILD RUMINANTS

CHAPTER TWENTY-FIVE

RESEARCH NEEDS

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

First printing, March 1982

Library of Congress Catalog Number 80-70984

CONTENTS OF CHAPTER TWENTY-FIVE

RESEARCH NEEDS

CHAPTER 25. RESEARCH NEEDS

Research is defined in Webster's New Twentieth Century Dictionary of the English Language (1980; unabridged) as " . . . careful, patient, systematic, diligent inquiry or examination in some field of knowledge, undertaken to establish facts or principles . . . " That definition has certainly been met by thousands of researchers that have published the papers on wild ruminants listed in this 7-PART series. Their work is essential for an understanding of the biology and management of wild ruminants. In fact, the responsibility for finding solutions to problems rests with researchers who devote their lives to understanding ecological relationships, not only of wild ruminant ecology, but human ecology as well. Successful management must recognize biological principles, and decision-making procedures and decisions made shoud be updated as new knowledge is gained.

In the absence of data obtained through actual experimentation, usable first approximations can be arrived at through synthesized ecological information already at hand. The use of computers makes possible large numbers of computations that would otherwise be impossible. Computers can avoid much duplication of effort and free scientists for more actual experimentation. In fact, the reference lists in these 7 PARTS have been compiled from computerized bibliographic data bases, and their use will avoid much duplication of effort.

Much good research is never published because the researchers are too busy to write up their findings. Their work is useless to others if they cannot learn from it. Unfortanately, state agencies do not always provide the time for their research biologists to publish their findings. Once the work has been done and the state report written, it is filed and often left unused.

One of the difficult decisions I had to make when beginning the reference lists was the kind of literature that should be included. I chose not to list unpublished, mimeographed reports, such as Pittman-Robertson Progress Reports. They are not readily available to students and other researchers, so listing of them seemed to be an exercise in futility. Theses were also not listed. Student researchers have a professional obligation to publish their results in professional journals. If they do not wish to meet that obligation at a critical time early in their career, the thesis is destined to remain on the shelf to be read by only a few, if any, biologists that follow.

Continued research is necessary to refine past work, make new discoveries, and correct past errors in observation and interpretation. It is often four to five years from the time work is completed until it is published, and often the results are needed now. The pressure to go on to new projects should be alleviated so writing need not be crowded into odd moments of an already-full day.

Another idea to consider here is the need for time to synthesize and write up what is already known. Indeed, this 7-PART series is such an attempt. The SERIALS format is my own way of organizing the literature available so I can work efficiently. I have not had the time to make the ecological syntheses as complete as it is possible to make them, but that will come If I should have no pressure to do anything else, progress would be much more rapid.

It is imperative that sound biological bases be the foundation for ecological syntheses. Given that premise, I have and shall continue to develop the most complete understanding of the total biological picture possible, and at the same time identify new problems for study. Such an approach seems to be the only practical way to bring our present knowledge of wild ruminants up-to-date.

TOPIC 1. BIOLOGICAL RESEARCH NEEDS

The first six PARTS of this series on THE BIOLOGY AND MANAGEMENT OF WILD RUMINANTS dealt with the basic biological characteristics of this group of species. How does one determine the biological research needs that remain to be met? The best way, given the extensive literature lists, might be to evaluate the number of references listed in each of the chapters, for each of the species. This will provide some indication of the general areas of biology which have not been reported on in the literature. Keep in mind that the SERIALS lists have been compliled from computerized literature data bases going back to about 1970, and from bibliographies and reference lists containing pre-1970 citations.

The list below gives the approximate number of references listed in each of the CHAPTERS.

CPTR		NMBR
1.	PHYSICAL CHARACTERISTICS	705
2.	ORGANS, GLANDS, CHEMICAL COMPOSITION, AND GENETIC	495
3.	COMMUNICATIONS AND THE USE OF SPACE	415
4.	PATTERNS OF BEHAVIOR	310
5.	INTERACTIONS WITHIN AND BETWEEN SPECIES	535
6.	SYSTEMS PHYSIOLOGY	720
7.	ENERGY METABOLISM	290
8.	PROTEIN METABOLISM	95
9.	MINERAL, WATER, AND VITAMIN METABOLISM	90
10.	METABOLIC AND BEHAVIORAL ALTERATIONS	1145
11.	THE CELLULAR BASIS FOR DIGESTIBILITY OF PLANT TISSUE	2465
12.	FORAGE CONSUMPTION	530
13.	PRIMARY PRODUCTION	345
14.	METEOROLOGY AND THERMAL CHARACTERISTICS OF THE RANGE	265
15.	THERMAL CHARACTERISTICS AND BASIC HEAT TRANSFER	85
16.	THERMAL ENERGY BALANCE CALCULATIONS	125
17.	RANGE APPRAISALS AND EVALUATIONS OF ANIMAL RESPONSES	605
18.	POPULATION STRUCTURES	405
19.	POPULATION ESTIMATES AND PREDICTIONS	495
20.	CALCULATIONS OF CARRYING CAPACITY	115
21.	MANAGEMENT OF WILDLIFE HABITAT	650
22.	BIOLOGICALLY-BASED SPECIES MANAGEMENT	535
23.	EXAMPLES OF IMPROPER ANIMAL: RANGE RELATIONSHIPS	105
24.	SOCIOLOGICAL AND ECONOMIC CONSIDERATIONS	135
	TOTAL	11660

A quick scan of the numbers above indicates that there are relatively few references available in the areas of protein, mineral, and water metabolism; thermal characteristics and energy balance calculations; numerical determinations of carrying capacity; and sociological and economic considerations.

A large number of references are available in the other areas of wild ruminant biology and management. CHAPTERS 10 and 11 contain 1145 and 2465, respectively. CHAPTER 10, METABOLIC AND BEHAVIORAL ALTERATIONS, includes the references on parasites and diseases. CHAPTER 11, FORAGE CHARACTERISTICS AND THE DIGESTIBILITY OF PLANT TISSUE, includes the references on the nutritive characteristics of forages.

There is not an overall shortage of references, though there are shortages in some areas of biology, and for some of the species as indicated below.

CPTR	odvi	odhe	ceel	alal	rata	anam	bibi	ovca	ovda	obmo	oram
1.	240	107	99	51	81	17	20	25	3	5	5
2.	133	83	59	19	54	18	11	8	7	5	3
3.	97	65	36	55	51	38	2	24	2	4	19
4.	54	41	21	69	28	27	6	27	2	4	11
5.	82	63	63	67	56	38	9	51	10	5	22
6.	218	101	78	39	81	21	16	19	4	7	4
7.	77	21	31	12	35	11	2	11	1	2	4
8.	30	6	5	3	8	1	1	1	1	2	2
9.	18	9	3	5	7	7	0	1	0	0	3
10.	314	99	96	63	87	43	33	67	2	10	8
11.	40	32	6	4	4	1	3	1	0	0	0
12.	186	88	43	35	29	39	9	7	0	5	4
13.	References are listed by plant species in this CHAPTER										
14.	References are listed by weather factors in this CHAPTER										
15.	8	1	0	0	12	0	0	0	0	0	0
16.	39	4	3	2	19	0	1	4	0	0	0
17.	212	109	36	46	43	11	2	14	0	7	4
18.	124	45	23	35	48	6	3	8	3	13	3
19.	189	77	38	30	36	24	4	15	1	9	0
20.	18	9	9	2	3	3	0	1	0	0	0
21.	182	50	48	26	22	10	6	43	1	3	7
22.	141	44	45	36	39	30	13	103	1	17	8
23.	30	12	15	4	1	4	0	5	0	0	0
24.	11	0	2	2	33	2	0	8	0	6	0
SUMS	2443	1066	759	605	777	351	141	443	38	104	107
PCNT	36	16	11	9	11	5	2	6	1	2	2
RANK	1	2	3.5	5	3.5	7	9	6	10	9	9

The numbers above include only those SERIALS in which the species is identified. The total number of references on the previous page includes not only those counted above but also the general references which are not identified by species.

There is a great need for synthesis of available knowledge. The numerical approach stressed in the seven PARTS in this Series should help make syntheses a little easier to accomplish.

UNIT 1.1: BASIC BIOLOGY

How does one judge the adequacy of the distribution of references in each of the CHAPTERS listed in TOPIC 1? Consider the objectives listed in "Research Needs in Wildlife" by Sanderson et al. (1979). They are:

1. Knowledge of the biology of species and ecosystems to accumulate a long-term data base on wildlife habitats and communities on a national scale.

2. Development of deductive formulation of specific reserch needs based on an understanding of biological processes, and utilizing long-term data on wildlife habitats and communities.

3. The capability to prescribe land-use designs for various wildlife communities based on predictive capabilities.

4. Predictive capabilities for dealing with effects on wildlife and habitats.

5. Understanding the minimum survival requirements of wildlife species, populations, and communities at all stages of their life cycles.

6. New methods, and improvement of existing methods for rapid transfer of information in a form readily understood and accepted by users.

These objectives can be reworded into statements of research needs that can be applied to wild ruminants. Note that there are several key words in the list above, such as long-term, biological processes, predictive, species, populations, communities, and rapid transfer of information. Consider the following needs:

We need knowledge and understanding of the biology of species, populations, communities and the ecosystems in which they are found.

We need long-term data in order to make and test predictive capabilities.

We need computer-assisted evaluations that allow users to easily input data for the populations and habitats which they are called on to evaluate and make management decisions for.

How can these needs be met? My suggestion is that first one must set up a comprehensive framework for the deposition of data. The first six PARTS in THE BIOLOGY AND MANAGEMENT OF WILD RUMINANTS is a framework for discussions and for the location of the data in the literature, with equations representing many of the biological processes discussed.

The equations presented are not the end, but the beginning however. They must be linked together to represent the continuity to biological processes. Just as suckling weight equations are directly linked with equations for weights of older deer so discontinuities are avoided in the weight curve, weights are linked with metabolism, and metabolism with forage required, and forage required with range production, and range production with population density effects on plant vigor, and plant vigor with vegetative cover, and vegetative cover with the stability of that foil-thin surface of the earth called soil, on which all life depends.

Is the sequence above logical? Is it imaginable? That is, can it be thought about? Are the relationships predictable? Yes, yes, yes . . . to all of these questions. What remains to be done? Convert our ideas, our thoughts to words and numbers. Put something down that represents your best understanding so you have something to evaluate, to test, to react to.

Let us attempt to synthesize, relate, and understand processes rather than merely memorize facts. With the aid of electronic circuits that respond to our commands with incredible speed, we can now simulate, test, and revise our evaluations of natural processes, always working toward perfection. When you begin to do this, your progress will simply amaze you.

How much more time and money should be devoted to research into biological processes? My suggestion is that, given the shortage of research funds at present (1982), we should spend more time thinking and evaluating what we do know and how it fits together and less time accumulating more data. I do not know how much more information is needed on certain biological processes of wild ruminants until I have evaluated how they fit into the larger picture, and how sensitive ecological relationships are to variations in those processes. If I cannot demonstrate how variations in those biological processes affect ecological relationships, then I am not ready to spend more time and money collecting data.

More biological research is needed, to be sure, but I am not yet sure what research is most needed. Writing this 7-PART series has certainly given me perspectives that I did not have before, and the syntheses I plan to do in the future represent exciting opportunities. I hope that many of you will join in that endeavor.

LITERATURE CITED

Sanderson, G. C., E. D. Ables, R. D. Sparrowe, J. R. Grieb, L. D. Harris, and A. N. Moen. 1979. Research needs in wildlife. Trans. 44th North American Wildl. Nat. Res Conf. 44:166-175.

REFERENCES, UNIT 1.1

BASIC BIOLOGY

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

rata

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
tdbca	6----	23	28	ovca	coord,life hstry,mgt study	banko,we; sumner,	1962
tdbca	6----	29	40	ovca	what makes a valid obsrvtn	welles,re	1962
tdbca	6----	73	82	ovca	studies, desert game range	hansen,cg	1962
tdbca	7----	19	25	ovca	loose end thinking	welles,re	1963
tdbca	12---	54	58	ovca	habitat stud, san gabrl mt	graham,h	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
ATRLA	12-35	495	501	bibo	problms for furthr studies	pucek,z	1967

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NZJFA	8---2	269	274	biga	deerstlkrs contrib, resear	henderson,jb	1960

OTHER PUBLICATIONS

Hjersman, H. A. Yoakum, J. D. 1959. The pronghorn as a range animal. Interstate Antelope Conf., Trans. 10:76-83.

Russo, J. P. 1954. Hunting, a key to research studies of Arizona bighorn. Proc. Ann. Conf. West. Assoc. State Game and Fish Comm. 34:195-200.

Yoakum, J. D. 1962. The interstate antelope range; its research and management needs. Interstate Antelope Conf., Trans. December:52-58.

UNIT 1.2: MANAGEMENT NEEDS

Management needs in relation to wild ruminants may number in the thousands if each species in each habitat in each state and province is considered to be a separate need. There will be as many management needs as there are programs. Inductive reasoning--the passing from specifics to generalities--has dominated wildlife research (Sanderson et al. 1979), and would be used if each specific situation were considered to be a management need. That luxury can no longer be afforded; it is too time-consuming.

The alternative is deductive reasoning. General principles may be stated and tested. General principles may be used to construct a framework within which relationships are evaluated. General principles may be evaluated by simulation, in fact they must be evaluated by simulation because we cannot control the extraneous variables which affect system functions. Specifically, the effects of a combination of deep snow, cold temperatures, and deer productivity cannot be put on next year's experimental agenda because next year may have little snow and warm temperatures. But if the effects of this combination are represented to the best of our abilities in simulations, the whole range of effects due to the whole range of potential combinations may be predicted, and next year's combination evaluated in relation to the predictions of effects.

Sanderson et al. (1979) state "Perhaps no single group of professionals is more reluctant to accept generality than wildlifers." I have experienced this reluctance as the applicability of my work under controlled conditions has been questioned in relation to field conditions. I try to explain that it is not the numbers themselves that are of greatest interest, but the patterns. Consider the seasonal metabolic rhythm paper in the Journal of Wildlife Management (Moen 1978). The metabolic pattern over the annual cycle is of definite significance to management. Deer attempting to conserve energy in the winter should not be disturbed; that is the significant general principle that comes from that work. Concerns over whether the multiple of base-line metabolism is 1.6 or 1.7 at its lowest point is much less significant. Further, the energetic effects of such a difference (0.1) on productivity can be evaluated mathematically.

A subsequent response to such an argument is that lack of concern over the actual values results in sloppy work. The argument is invalid; one uses the best values available. That is very different from saying one does not want good values.

Why include the above paragraphs in this unit on management needs? Because the greatest need in management today centers on the comprehensive synthesis of the biology and management of wild ruminants. Such a synthesis involves inventory of populations, evaluations of population requirements, evaluations of range resources, simulations of requirement: resource balance fluctuations, and evaluations of the effects of these fluctuations. These effects are biological, sociological, and economic.

All three effects--biological, sociological, and economic--must be considered. Biological effects are fundamental, however. No matter how much people want something to be true, no matter how much money is available to buy something, no matter how democratic the vote is--there are certain biological characteristics of species that remain in effect. Muskox will never have several calves each year. Pronghorn will never adapt to the northeastern forests. Mountain goats will never live and reproduce naturally in the southern forests. These are extreme examples, but they illustrate a point. Less extreme situations need more comprehensive analyses. Should moose be reintroduced into the Adirondacks of New York? Should the woodland caribou be reintroduced into northeastern Minnesota? Should the timber wolf also be reintroduced into the Adirondacks? Is the prey base (deer) too small for the present number of timber wolves in northeastern Minnesota? What potential competitions are there between deer, moose, and caribou in Minnesota? These are more subtle ecological questions, and they do not stop with a yes or no answer. These management questions could go on and on, and the answers (note the plural) cannot be arrived at without thorough understanding of basic biology and of ecological relationships in the natural world.

LITERTURE 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.

Sanderson, G. C., E. D. Ables, R. D. Sparrowe, J.R . Grieb, L. D. Harris, and A. N. Moen. Research needs in wildlife. Trans. of the 44th North American Wildl. and Natural Resources Conference 44:166-175.

REFERENCES, UNIT 1.2

MANAGEMENT NEEDS

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
EXPEA	32--5	663	666	alal	domesticatn, resrch trends	hemmer,h	1976

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

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
tdbca	6----	1	7	ovca	an appraisal of techniques	;pw.kb	1962

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
NAWTA	36---	383	396	wldl	human beh and w		
WLSBA	4....	51	54	wldl	future of wildlife managem	scheffer,vb	1976

OTHER PUBLICATIONS

Hjersman, H. A. Yoakum, J. D. 1959. The pronghorn as a range animal. Interstate Antelope Conf., Trans. 10:76-83.

Yoakum, J. D. 1962. The interstate antelope range; its research and management needs. Interstate Antelope Conf., Trans. December:52-58.

UNIT 1.3: RAISING WILD RUMINANTS FOR RESEARCH

Experimental work on free-ranging wild ruminants is difficult, and many types of experiments that would result in significant information are impossible. There are many reasons for this, including the wild, elusive, and secretive nature of wild ruminants, their large sizes and large home ranges, their longevity, and technical problems with equipment used in the field and mounted on or implanted in the animals. The alternative to working on free-ranging animals is to work with captive animals.

Raising wild ruminants for research is a specialized endeavor, not like raising domestic cattle or sheep. Animals raised for research purposes should be tractable, but yet in possession of all of their wild instincts. Thus they may appear to be tame, but they are not. This has been the case for the whitetail fawns raised at the Wildlife Ecology Laboratory, Cornell University, over the years. They come running up to those of us that handle them, but any attempt to restrain them as one would a calf or lamb results in a struggling fawn. Veterinarians have learned that by experience on a few occassions. Before discussing techniques used to raise wild ruminants, the uses of hand-reared animals should be mentioned.

Hand-reared animals have been used in several food habits studies in recent years. These animals are called "lead" animals, and are accompanied by a researcher as they move through the habitat and select food. The best way to conduct such studies is to hand raise and tame the animals as neonates, place radios on them for location, and then allow them to live in the natural habitat, finding them by radio-location when the food habits observations are to be made. The animals need not be transported and released in a new area then, which can bias their selections of forages.

The raising and releasing of animals as described above is a very useful way to evaluate the finer details of daily activities. The researcher can walk with the animals, bed down with the animals, be with them constantly . . . for 24-hour cycles, recording not only the general activities but also details such as urinations, defecations, bedding postures, levels of alertness, ruminations, leg positions, and more. An added bonus is that wild animals will associate quite readily with such a tamed animal, and will tolerate the presence of a researcher, resulting in observations of wild animals in addition to the tamed one. This was discussed in PART II, CHAPTER 5 in relation to the work by V. Geist on sheep and L. Rogers on white-tailed deer.

Wild ruminants have also been kept in captivity for physiological telemetry studies. Heart rates have been monitored for many years at the Wildlife Ecology Laboratory (See Moen 1978), and brain wave patterns have also been tried, but without significant success. These studies were conducted on very tractable white-tailed deer living in a 6-acre yard, with a smaller telemetry pen where experiments were conducted. Physiological studies on whitetails have also been completed at the University of New Hampshire where deer have been kept in a metabolism chamber while oxygen consumption and heart rates have been measured during the same time periods. These deer were conditioned to confinement in the chamber.

Nutrition studies, behavior studies, reproductive studies, and other kinds of studies have been done on captive ruminants out of necessity; measurements of these biological functions simply cannot be made on free-ranging animals, especially the finer details.

How should wild ruminants be raised in captivity in order to have tractable animals that are still wild? There seems to be general agreement in the literature on several important points.

Avoid making loud noises, rapid movements, and other stimuli that would result in a fright response. This allows the animals to become accustomed to the handlers rather than associating fright with them. The handlers want to be accepted by the animals.

Use a reward system, giving them the bottle, food, or some delicacy when they complete a "task." Fawns at the Wildlife Ecology Laboratory are weighed on a platform scale and rewarded each time they step on the scale. Raisins were particularly good as delicacies. Schwarze et al. (1976) used rewards extensively when training pronghorns.

Neonates seem to do respond better and problems with constipation are lessened when the hind quarters are massaged while bottle feeding. This stimulates defecation and urination. A wet sponge may be used around the anal area, or the hind quarters may be rubbed by hand. This practice simulates the licking by the dam while young are nursing.

Different milk formulas have been tried by researchers feeding different species. Whitetail fawns at the Wildlife Ecology Laboratory were fed canned evaporated milk mixed with equal parts water. Pronghorn fawns were fed 1 part canned evaporated milk and 4 parts homogenized milk (Schwarze 1976). Colostrum is important in the first few days; colostrum from dairy cows may be frozen and used when necessary. Milk has been fed from baby bottles or soft-drink bottles. Sheep nipples work best because of their longer lengths than baby nipples, and they fit easily on soft-drink bottles.

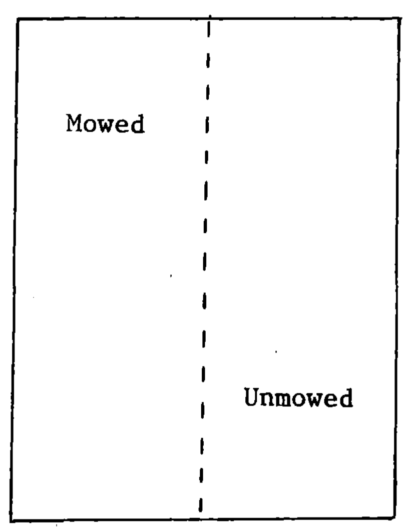
The amount fed should vary with the size and age of the animal. New-born pronghorns and whitetails have been given less than 500 ml per day, which seems like a very small amount when divided into 4 to 6 feedings. Overfeeding is a greater problem than underfeeding, however. The amounts of milk fed over the 100-day nursing period are illustrated in Moen (1973) and Robbins and Moen (1975).

Milk is usually warmed when fed, although we used tap water without heating it further for some of the fawns. There have been no problems with using unheated milk, and the use of cold milk may reduce bacterial growth. The bottles have been washed but not sterilized between feedings, unless a sick fawn was involved. We have labeled the bottles individually, using the same one for each animal at each feeding.

Sickness has been a very minor problem at the Wildlife Ecology Laboratory. It is much better to employ preventive measures than having to employ corrective ones. The fawns are raised in movable wire netting cages, with the cages moved to new grass every few days. Two fawns occupy each cage. A canvas sun shade protects the fawns from exposure to the hot sun. After they are drinking well from the bottle, they are let out of the cage for exercise in the 6-acre yard, and then bottle-fed in the cage and confined. After a few days they may be left out in the 6-acre yard between feedings. A bell has been used to call them, though the rattle of the bottles in the carrier has been enough of a stimulus to attract them most of the time. The bell resulted in remarkable conditioning; fawns would come from all over the yard when the bell rang. If a fawn does not come, no attempts are made to force-feed it. The next feeding usually finds a hungry fawn waiting.

The deer yard at the Wildlife Ecology Laboratory is unique in not having any trees. It is a 6-acre open field, with wooden-slatted snow fencing used to provide visual and weather protection. The telemetry pen and the nutrition pen were both made of two layers of 4-foot high snow fencing, and additional stretches of one height were placed in different areas to provide protection from the wind. Wooden-slatted snow fencing is inexpensive, movable, and resilient. Just-born fawns occasionally squeeze between the slats.

The grass in the deer yard is mowed in the pattern shown in the sketch below. The deer usually grazed on the mowed area and almost always bedded in the long grass. Horse pellets, the lowest-protein (12%) feed available, was offered at all times. The deer have gained well, there have been no problems with diseases, and the treeless yard provides a grassy surface rather than a muddy one, which has kept the deer and the yard much cleaner than would be the case if trees are a congregating place with subsequent destruction of the grass.



The potential for disease always exists in such captive herds. The biggest problem at the Wildlife Ecology Laboratory resulted from the acceptance of a fawn from another area that turned out to be affected with dermatosis. This was corrected by quarantine nd subsequent preventive measures. Fawns were no longer accepted from any other deer facility after that episode.

It is a good idea to provide the young animals with a few drops of multi-vitamin formula in the milk. As they grow older and become functional ruminants, this is no longer necessary.

The key to success in raising tractable wild ruminants is the "TLC" given from the very first contact. This, coupled with a very slight underfeeding tends to make them dependent on the handler for their phyysical needs, and a high level of affinity can be developed.

LITERATURE CITED

Moen, A. N. 1973. Wildlife Ecology. W. H. Freeman Co., San Francisco. 458 p.

Robbins, C.T. and A. N. Moen. 1975. Milk consumption and weight gain of white-tailed deer. J. Wildl. Manage. 39(2):355-360.

Schwartz, C. C., J. G. Nagy, and S. M. Kerr. 1976. Rearing and training pronghorns for ecological studies. J. Wildl. Manage 40(3):464-468.

REFERENCES, UNIT 1.3

RAISING WILD RUMINANTS FOR RESEARCH

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
ZOLZA	39...	1892	1894	cerv	[feeding of fawns]	gabuzov,os	1960

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	24--4	439	441	odvi	rear & breed fawns in capt	murphy,da	1960
JWMAA	25--1	94	95	odvi	feeding the wh-t deer fawn	long,ta; cowan,r/	1961
JWMAA	26--3	340	341	odvi	rearing fawns in captivity	trainer,do	1962
JWMAA	39--1	211	214	odvi	impr husbandry, rear captv	buckland,de; abl/	1975
PCGFA	22---	128	133	odvi	cryo-branding,marking tech	newsom,jd; sulliv	1968

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
AMNAA	100-2	493	....	odhe	artificially raising fawns	halford,dk; alldr	1978
JWMAA	35--2	205	209	odhe	diarrh, captv fawn, _e coli_	kramer,tt; nagy,/	1971

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	33--2	467	470	ceel	rear red deer calv, captiv	youngson,rw	1969
JWMAA	43--2	568	570	ceel	rear, train calv, food hab	hobbs,nt; baker,d	1979

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

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	33--4	1032	1033	anam	entero toxemia, hand-reard	nagy,jg; barber,/	1969
JWMAA	40--3	464	468	anam	rear & train, ecol studies	schwartz,cc; nag/	1976

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CAFGA	41--2	131	143	ovca	rearing bigh lambs, captiv	deming,ov	1955

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
IZYBA	16...	126	129	ovda	breeding at milwaukee zoo	bullermann,r	1976

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	25--3	295	302	ungu	care, mgt wild ungu, exper	wood,aj; nordan,/	1961
MILUB	4---1	85	115	many	species maintained at zoo	petzold,h-g	1976

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
IZYBA	4----	295	296	dada	notes on hand-rearing deer	klopfer,ph; klopf	1962
IZYBA	7----	168	171	dada	caca, artifi rearing, park	wayre,p	1967

TOPIC 2. SOCIOLOGICAL RESEARCH NEEDS

One of the areas of greatest need for research is in the sociological area. Society has changed so much in the last few years, and increased communication capabilities now make it possible for practically the whole world to be in almost continuous contact. The impact of such capabilities on people is tremendous.

Psychological characteristics of people may not change, but the use of psychgology to change opinion, muster support for certain causes, and gain control over significant segments of thought has never in the history of mankind more possible and more frightening. How much do wildlifers know about these possibilities?

Politics is a part of life. "Playing politics" is part of the wildlifers daily routine in many instances. How do we "play politics" without comprimising ecological principles? What kinds of personalities and approaches have the greatest impact on politicians and the electorate? How much credit should be given to the electorate for understanding ecological principles?

These and other considerations are discussed briefly in the next two UNITS on psychology (UNIT 2.1) and politics (UNIT 2.2).

UNIT 2.1: PSYCHOLOGICAL FACTORS

The need for understanding the psychology of humans in the milieu in which the vast majority of our population lives is becoming rapidly more important. While humans do not change appreciably, the environments we create by urbanization, suburbanization, centralization, communication . . . are so vastly different from the hunting, pastoral, rural, agricultural environments that so many of us grew up in about the middle of the 20th century that we may have trouble adjusting to the new mood of the people of the land.

It is easy for those of us over the age of 40 and in possession of a farm or rural background to assume that other persons share in not only our concern for wildlife, but our knowledge of some of their basic characteristics. There may be an apparent concern, and there may be some knowledge, but both are easily overestimated.

As a professor in the College of Agriculture and Life Sciences at Cornell University, I have noted an increase in the lack of field experience of undergraduate students in wildlife science over the last 15 years. Most of them do not hunt, nor do they spend much time in the field on their own.

Are Cornell students unique? I think not. They are products of the environmental movement and suburbia, not unlike their peers at major universities across the country. They are in wildlife because they have had exposure to camping, they like wildlife, and they have been emotionally drawn to it, primarily through television. One-minute or half-minute spot announcements provide an emotional appeal that persuade them to devote their educational opportunities in college to this field, even if it means a "liberal science" education with little hope of finding professional employment.

I have also learned that, while they are inexperienced in the field, they are very capable in other ways, of combining a rather sophisticated high school and college education with some of the practical aspects of field work. They simply need more field opportunities throughout the year.

They are entering the field of wildlife management at a very challenging time, and it may be that they must be counted on to bridge the gap between the old-timers and the new society. In fact, they may do it better than any of us pre-earth day individuals could.

What must they do to bridge the gap? They must understand both the basic ecology of species and the psychology of society. Much is known about the former, little about the latter.

The psychological reactions of various segments of society are of greater importance than small errors of estimation in body weights, ecological metabolism, forage intake, population structures, and population predictions. In fact, our biological knowledge is so far ahead of our knowledge of the basic characteristics of a restless society that it is imperative that we devote considerable time to the analysis of groups ranging from the devoted hunter to the most skilled anti-hunting proponent.

One of the more enlightening experiences I have had in recent years was that of listening to one of the officers of "Friends of Animals." His presentation clearly indicated a marked lack of knowledge about the biology of white-tailed deer. One of his main points was that we spend too much money on deer and we neglect non-game species. So much money is spent for deer management and habitat improvement when there are greater needs for attention to other species. Furthurmore, he believed that the wildlife manager raises deer only to shoot them, and he was opposed to hunting.

The opposition of this young man to hunting is not atypical of those in his age group. Why is he opposed to hunting? There are undoubtedly several reaons why, but one main reason came out in the discussion after the formal meeting. This young man was a veteran of Viet Nam. He had been on the battlefield with soldiers jumping out of foxholes and spraying bullets in all direction, hoping to hit an appropriate target. He was clearly shaken by the use of guns, and for good reason. He assumed that hunters do the same thing, and that opening day in the field is characterized by hunters shooting in all directions, hoping that they, too, hit something. He spoke about the scenario on opening day in such terms, and while it is not the typical situation in the backwoods of Upper Michigan or Maine on opening day, there have been instances where the number of hunters has been much too high, hunting pressure has been much too great, and hunters much too irresponsible to dispel such notions.

Since the population dynamics effects of prohibiting hunting may be predicted with a high level of certainty, it is important that psychological issues such as anti-hunting sentiment be understood and dealt with in a rational rather than an emotional way. Participation in hunting must be an individual decision when hunting is desirable or necessary for population control. There may be very good reasons why some persons do not wish to hunt. In fact, the psychological progression in attitude towards hunting by professionals follows a fairly definite pattern, characterized by no less than Aldo Leopold and Sigurd Olson, both well-known in the field of ecology and wildlife. Both hunted as youth, but as they became more involved in the ecology of species and the land, their interest in hunting waned and their interest in the hunted increased.

There is much room for innovation in the ways in which hunting and hunters are regulated. As the numbers of hunters has increased, some states have gone from a single high-density opening day to staggered opening days. Quota systems are used to spread hunting pressure out in both time and space. More could be done by many states, along with minimizing of "special hunts" that seem to attract so much attention by the media. Prevention of problems is always so much easier than the correction of problems, and it would be most desirable if biologists and psychologists could get together on developing formats that would be ecologically reasonable and much more psychologically acceptable to significant segments of society.

REFERENCES, UNIT 2.1

PSYCHOLOGICAL FACTORS

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

rata

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

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

NAWTA 36--- 383 396 wldl human behavior, wldlf mgmt ; potter,dr 1971

UNIT 2.2: POLITICAL FACTORS

Politics have always played a significant role in wildlife management. It is through political action that laws are enacted which have established wildlife managment areas, state and national forests, parks, wilderness areas, and many other kinds of areas set aside that result in direct or indirect benefits to wildlife.

Politics have also been very important in determining the mechanisms, if not the actual dates, for setting seasons. Some of these are arbitrary, and some are based on the recommendations of biologists concerned. What should our views of politics be as professional biologists in democratic societies?

Political action should be viewed as the mechanism used by democratic societies to maintain order. Biologists would like more control over the setting of seasons and other decisions pertaining to wild ruminants and other forms of wildlife. Dentists and doctors would probably like more control over their roles in society too, as would teachers and lawyers. If each group were given the privilege of setting policy and practices pertaining to their areas of interest and expertise, chances are pretty good that, in the absence of checks and balances, the system would go out of balance.

The alternative seems to be for professional groups to form professional societies that become forums for debate, decisions, resolutions, professional literature, and certification. Then, the body as a whole can present its views on particular matters, and politicians will havemore options to weigh on behalf of their constituency.

The format for progress in politics is one of continuing education, in a formal sense as ecology and wildlife biology is part of public school curricula and in an informal sense as the media and personal talks are used to help the public understand the viewpoints of our profession better. The last educational practice employed prior to the enactment of a bill is called lobbying, a very special kind of education for a particular purpose.

What research should be done in relation to managment of wild ruminants? I suggest that the very best managment programs, the very worst management programs, and a good representation of programs between these two extremes be evaluated with respect to the decision-making process, determining where the decisions were made that resulted in good, bad, or indifferent managment. Are the most important decisions being made by biologists, by legislators, by a commissioner, or by whom? Are there decision-making formats that are optimum in different situations? What kinds of questions are vulnerable to marginal answers at different levels of decision-making? What kinds of questions should be answered by biologists, and what kinds by lawmakers?

It is my opinion that the more comprehensive the synthesis and the more clear the picture of ecological alternatives, the greater the chances are that political decisions will be made within a viable ecological framework. I have gained the reputation of being involved in the details of white-tailed deer biology to a high and perhaps excessive degree. I have been criticized for taking such a numerical approach. I have been thought of as a specialist, and they know more and more about less and less. From the very beginning of my research at Cornell University, however, I have felt that the greatest need for the kinds of results I am getting will not be felt by the biologist, but by the lawyers and judges. The time will come, I have told my classes, when I will be called as an expert witness, and I intend to be prepared to discuss every aspect of deer biology that I am called on to discuss. Furthr, I intend to discuss biological functions in numerical terms, demonstrating how one function is linked to another numerically, just as one function is linked to another biologically.

One example will illustrate the usefulness of this approach in relation to the political arena. Harriman State Park, New York has been closed to deer hunting for many years. A season was opened in 1981, only to be closed almost immediately by court order. In the meantime, biologists were able to collect 12 sets of antler beam diameters and dressed weights of yearling males. The mean antler beam diameter ws 11.6 mm, and the mean dressed weight was 67.4 pounds. Equations in Severinghaus and Moen (1982) indicate that the predicted average dressed weight should be 70 pounds, which is only 4% different from the observed. Also, reproductive rates of the females on such range is expected to be 0.0 for fawns, 0.47 for yearlings, and 1.33 for adults, much less than expected on good deer range in New York State.

The weights of these deer were also compared to the weights given in Moen and Severinghaus (1981) for deer on different ranges in New York State. It was shown by the graphs calculated with equations in that paper that the deer were very small due to deteriorating range conditions, and that they were very close to the weight of no return even before the winter began. This kind of evidence rather than subjective opinion resulted in decisive action by the judge. The hunting season was opened again, less than one week after it had been closed. Similar cases are expected in the future, and I am prepared to present as much evidence as humanly possible on the way biological processes function and relate in the natural world. If the public is exposed to such comprehensive thinking, perhaps there will be greater acceptance of certain management practices, and the courts will have fewer cases to decide on an emergency basis.

There is much to learn about the political process in today's society, especially about the various segments of society that bring pressure for their own interests on politicians and both the legislative and judicial processes.

LITERATURE CITED

Moen, A. N. and C. W. Severinghaus. 1981. The annual weight cycle and survival of white-tailed deer in New York. New York Fish and Game Journal 28(2):162-177.

Severinghaus, C. W. and A. N. Moen. 1982. Prediction of dressed weights and reproductive rates of white-tailed deer from yearling antler beam diameters. New York Fish and Game Journal 29:(In press).

REFERENCES, UNIT 2.2

POLITICAL FACTORS

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

rata

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

oram

TOPIC 3. ECONOMIC RESEARCH NEEDS

There have always been attempts to place dollar values on wildlife, with only partial justification. Some wildlife values, such as the value of the meat, can be legitimately given dollar values, and others, such as the value of a view with elk or moose or sheep foraging on a hillside cannot be represented by any economic unit of measurement. All too often, the value of the elk grazing is not determined directly, but the question is turned around and values assigned to a replacement, such as an oil well, and the question asked "Is an elk worth more than $XXX which this oil well will yield over the next several years?"

One of the most urgent needs for research in the realm of natural resource economics is in the area of question-formulation. "How to lie with statistics" has a counterpart in the formulation of questions. The question at the end of the paragraph above is not a legitimate one.

The wildlife professional should know what questions are legitimate so answers are formulated which direct attention to the issues and not to the questions themselves. The question of legitimacy is answered in different ways by different people. Thus there are elements of psychology involved too, and it is important to know the backgrounds and reasons for the asking of particular questions.

This TOPIC includes discussions of two areas of research needs in economic analyses; cost-benefit ratios (UNIT 3.1) and dimensionless values (UNIT 3.2). Since they are such distinctly different measures, it is important that both are understood so the appropriate measures are applied in the appropriate places. The business community knows about the first of these only. The wildlife biologist must know about both in order to keep economic analyses in perspective.

UNIT 3.1: COST-BENEFIT RATIOS

Cost-benefit ratios seem to simple and straight-forward. Simply divide the costs by the benefits, and compare to the value before treatment. If the benefits derived exceed the costs and the benefits from the present situation, then proceed with the development. If not, reconsider, redo the cost-benefit analyses, and see if there isn't some way to demonstrate the ultimate value of the proposed treatment (or development). Right? WRONG.

Economists are hesitant to predict the value of the dollar or the price of gold very far in advance. Yet the wildlife values which are being given a price effectively bear that price for years and generations to come. The passenger pigeon wasn't worth much on the market when it was abundant. Now, its value is very high--infinite, perhaps--since it is extinct. No amount of money can bring it back.

It is so important to take a forward look when evaluating the application of cost-benefit ratios to wildlife. Decisions simply should not be made on the current value of meat, or hunting expenditures, or film for photographing, or any other current expense associated with the animals. How much do we know about such projections, however? All too often we give up trying to count animals present, much less make predictions of their numbers and value in the future. Isn't it time that we give up our fatalistic attitudes toward some of these specifics and begin looking at overall patterns and generalizations, especially those which can be represented numerically to provide some estimate of their status in the future?

Consider the exponential population predictions in PART VI, CHAPTER 20. That quick method can be used to predict numbers for as many years in advance as you wish to recognize reasonable estimates of natality and mortality rates. Since it is highly unlikely that deer will ever have litters of 5, 6, 7 . . . fawns, isn't it reasonable to use realistic values currently available to estimate numbers of animals in years to come when a particular area of their habitat is being considered for "development?" Rather than let the developer take the initiative and come up with a cost-benefit analyses that must be refuted by the wildlifer, let the wildlifer come up with a cost-benefit analyses for the developer to consider.

Increased research on the part of wildlife biologists into not only ecological functions and syntheses but also economic analyses may help put the wildlife biologist in a postion of initiative rather than defense.

The Wildlife Society has taken an important step toward economic literacy by requiring coursework in resource economics in order to grant certification to individuals. It will likely take a generation for that to perfuse into the field, and the first persons will come with coursework taught by economists who have little knowledge of natural resources and ecosystem functions, but in time perhaps the two fields will be mastered by individuals who can then teach both aspects of the problem.

One staggering aspect of the need for research into economics is the rapid increase in costs and, hence, values while the value of the dollar declines. Values assigned in one year are outmoded by the next year. Research is needed into processes rather than absolute values, searching for processes that can be employed as new conditions and circumstances arise rather than simply determining numbers that can be used. Businesses, companies, investment firms . . . all are willing to use any value they might find for wildlife that gives some element of security by its mere existence, and they, not familiar with ecological processes, will think that such a value is in fact an adequate represenation of the truth.

The process approach has much more long-term usefulness than the accumulation of facts. Research into processes should be high priority for persons with educations in both economics and ecology. Such areas should be represented by persons with degrees in both fields, enabling such persons to be not only conversant but also knowledgable enough to make or contribute significantly to decision-making.

REFERENCES, UNIT 3.1

COST-BENEFIT RATIOS

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

rata

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

oram

UNIT 3.2. DIMENSIONLESS VALUES

Research into dimensionless values seems to be a paradox to the scientific mind, because research is conducted by making measurements. Dimensionless values cannot be measured, however, so we are faced with the impossible. Dimensionless values are important, so ways must be found to represent them and include them in decision-making.

Science in the traditional sense may be the simplest of endeavors. Measurements with precision devices, calibrated in defined units of measurements, are very much simpler than the subjective evaluations necessary when dealing with matters of judgement, with dimensionless values. Scientists are generally uncomfortable with dimensionless values, preferring rather to have the security of defined units and statistical tests to make decisions. Is it possible that the most objective measurements might also yield the greatest sense of false security?

Perhaps scientists do not deserve the esteem in which they are sometimes held, and perhaps those of us that are scientists should look up more to the philosopher. Our most advanced degree is given the name "Doctor of Philosophy" which, literally interpreted, means "lover of wisdom." I like that definition. I would intensely dislike a definition such as "lover of facts," or "lover of numbers," or "lover of some other scientific term."

What are the research needs in dimensionless values? The objective approach discussed in the first six PARTS and most of this seventh PART provides a framework of natural laws within which decisions must be made. The tolerances within this framework are appropriate for subjective evaluations, for decisions that may be dependent on the will of the majority, or the recommended judgements of those who have the foresight to make decisions that will benefit future generations.

There are examples of previously-made decisions by persons with considerable foresight that have benefited the present generation. Consider the National Parks and the foresight of President Roosevelt, for example. The scenic values, not subject to evaluations in dollars, were preserved for future generations by foresighted individuals. Do we not agree that such decisions were good? Yet these decisions come under almost continuous attack by persons interested in short-term gains.

My personal philosophy is definitely a conservative one. I question how much responsibility we humans should be willing to accept with regard to the management of natural systems. I also question how much we should be willing to impact natural systems, especially the relicts that are still with us. Being conservative, I suggest that we should not extend ourselves too far. H. D. Thoreau said, in WALDEN:

> "Individuals, like nations, must have suitable broad and natural boundaries, even a considerable neutral ground, between them."

Assuming that posture, it is imperative then that we do not become too abundant, too demanding, too expectant, too optimistic . . ., but rather be content with what we have, limit our numbers by making appropriate preventive-type decisions rather than remedial ones, and look to the simpler things in life for fulfullment.

LOOK DOWNWARD: "If you are too busy to key out a violet, you are too busy" (Memo to A. N. Moen from A. N. Moen).

LOOK INWARD: "But it is a characteristic of wisdom not to do desparate things" (H. D. Thoreau in WALDEN).

LOOK UPWARD: "The heavens declare the glory of God; and the firmament firmament sheweth his handywork" (Psalms 19:1; King James Version).

CLOSING COMMENTS

The completion of the last CHAPTER in this 7-PART series on THE BIOLOGY AND MANAGEMENT OF WILD RUMINANTS results in a sense of relief which will last for a few days at most, in a sense of inadequacy that will stimulate me to improve the material, and in a sense of anticipation as I not only use the CHAPTERS and SERIALS as they are but analyze, synthesize, and write more. My enjoyment comes from writing, and my enjoyment will be most complete when I find that these written words have been useful to others, especially students, who are the wild ruminant biologists of the future.

Aaron N. Moen
March 21, 1982

Serials are identified by five-character, generally mnemonic codes called CODEN, listed in 1980 BIOSIS, LIST OF SERIALS (BioSciences Information Service, 2100 Arch Street, Philadelphia, PA 19103).

The headings for the lists of SERIALS are:

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

The volume and issue numbers (VO-NU) are given after the CODEN entry, followed by beginning page (BEPA), ending page (ENPA), species discussed (ANIM)1, KEY WORDS from the title, AUTHORS [truncated if necessary, slash (/) indicates additional authors], and YEAR.

AMNAA American Midland Naturalist
ATRLA Acta Theriologica (Poland)

CAFGA California Fish and Game (US)

EXPEA Experientia (Switzerland)

IZYBA International Zoo Year Book

JWMAA Journal of Wildlife Management (US)

MILUB Milu

NAWTA North American Wildlife and Natural Resources Conference, Transactions of the (US)
NZJFA New Zealand Journal of Forestry

PCGFA Proceedings of the Southeastern Association of Game and Fish Commissioners (US)

tdbca Transactions of the Desert Bighorn Council

WLSBA Wildlife Society Bulletin

ZOLZA Zoologicheskii Zhurnal (USSR)

GLOSSARY OF ANIMAL CODE NAMES

Wild ruminants are referred to in this CHAPTER by a 4-character abbreviation from the family, genus and genus-species. These are listed below under Abbreviation.

Scientific names of North American wild ruminants are those used in BIG GAME OF NORTH AMERICA, edited by J.C. Schmidt and D. L. Gilbert (1979: Stackpole Books, Harrisburg, PA 17105, 494 p.), and may be different from the scientific names given in the original literature.

The abbreviations used for North American wild ruminants are listed below.

CLASS: MAMMALIA

ORDER: ARTIODACTYLA	Abbreviation
FAMILY: CERVIDAE	cerv
GENUS: *Odocoileus* (deer)	od--
SPECIES: *O. virginianus* (white-tailed deer)	odvi
O. hemionus (mule deer)	odhe
GENUS: *Cervus* (Wapiti, elk)	ce--
SPECIES: *C. elaphus*	ceel
GENUS: *Alces* (moose)	
SPECIES: *A. alces*	alal
GENUS: *Rangifer* (caribou)	
SPECIES: *R. tarandus*	rata
FAMILY: ANTILOCAPRIDAE	
GENUS: *Antilocapra*	
SPECIES: *A. americana* (pronghorn)	anam
FAMILY: BOVIDAE	bovi
GENUS: *Bison* (bison)	bi--
SPECIES: *B. bison*	bibi
GENUS: *Ovis* (sheep)	ov--
SPECIES: *O. canadensis* (bighorn sheep)	ovca
O. dalli (Dall's sheep)	ovda
GENUS: *Ovibos*	
SPECIES: *O. moschatus* (muskox)	obmo
GENUS: *Oreamnos*	
SPECIES: *O. americanus* (mountain goat)	oram

The abbreviations used for European wild ruminants are listed below.

	Abbreviation
CLASS: MAMMALIA	
ORDER: ARTIODACTYLA	
FAMILY: CERVIDAE	cerv
GENUS: Capreolus (roe deer)	ca--
SPECIES: C. capreolus	caca
GENUS: Dama (fallow deer)	da--
SPECIES: D. dama	dada
GENUS: Cervus (Wapiti, elk)	ce--
SPECIES: C. elaphus (red deer)	ceel
GENUS: Alces (moose)	
SPECIES: A. alces	alal
GENUS: Rangifer (caribou)	
SPECIES: R. tarandus	rata
FAMILY: BOVIDAE	
GENUS: Bison (bison)	
SPECIES: B. bonasus	bibo
GENUS: Capra (ibex, wild goat)	cp--
SPECIES: C. aegargrus(Persian ibex)	cpae
C. siberica (Siberian ibex)	cpsi

OTHERS

Abbreviations for a few other species and groups of species may appear in the reference lists. These are listed below.

Axis axis (axis deer)	axax
Elaphurus davidianus (Pere David's deer)	elda
Cervus nippon (Sika deer)	ceni
Hydropotes inermis (Chinese water deer)	hyin
Muntiacus reevesi (Chinese muntjac)	mure
Moschus moschifer (Chinese musk deer)	momo
Ovis nivicola (snow sheep)	ovni
Ovis musimon (moufflon)	ovmu
Ovis linnaeus (Iranian sheep)	ovli
Rupicapra rupicapra (chamois)	ruru
big game	biga
domestic sheep	dosh
domestic cattle	doca
domestic goat	dogo
domestic ruminant	doru
herbivore	hrbv
mammals	mamm
three or more species of wild ruminants	many
ruminants	rumi
ungulates	ungu
vertebrates	vert
wildlife	wldl
wild ruminant	wiru

JULIAN DAY: MONTH AND DAY EQUIVALENTS*

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Day
1	001	032	060	091	121	152	182	213	244	274	305	335	1
2	002	033	061	092	122	153	183	214	245	275	306	336	2
3	003	034	062	093	123	154	184	215	246	276	307	337	3
4	004	035	063	094	124	155	185	216	247	277	308	338	4
5	005	036	064	095	125	156	186	217	248	278	309	339	5
6	006	037	065	096	126	157	187	218	249	279	310	340	6
7	007	038	066	097	127	158	188	219	250	280	311	341	7
8	008	039	067	098	128	159	189	220	251	281	312	342	8
9	009	040	068	099	129	160	190	221	252	282	313	343	9
10	010	041	069	100	130	161	191	222	253	283	314	344	10
11	011	042	070	101	131	162	192	223	254	284	315	345	11
12	012	043	071	102	132	163	193	224	255	285	316	346	12
13	013	044	072	103	133	164	194	225	256	286	317	347	13
14	014	045	073	104	134	165	195	226	257	287	318	348	14
15	015	046	074	105	135	166	196	227	258	288	319	349	15
16	016	047	075	106	136	167	197	228	259	289	320	350	16
17	017	048	076	107	137	168	198	229	260	290	321	351	17
18	018	049	077	108	138	169	199	230	261	291	322	352	18
19	019	050	078	109	139	170	200	231	262	292	323	353	19
20	020	051	079	110	140	171	201	232	263	293	324	354	20
21	021	052	080	111	141	172	202	233	264	294	325	355	21
22	022	053	081	112	142	173	203	234	265	295	326	356	22
23	023	054	082	113	143	174	204	235	266	296	327	357	23
24	024	055	083	114	144	175	205	236	267	297	328	358	24
25	025	056	084	115	145	176	206	237	268	298	329	359	25
26	026	057	085	116	146	177	207	238	269	299	330	360	26
27	027	058	086	117	147	178	208	239	270	300	331	361	27
28	028	059	087	118	148	179	209	240	271	301	332	362	28
29	029	[060]	088	119	149	180	210	241	272	302	333	363	29
30	030		089	120	150	181	211	242	273	303	334	364	30
31	031		090		151		212	243		304		365	31

* For leap year, February 29 = JDAY 60. Add 1 to all subsequent JDAYs.