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

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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.

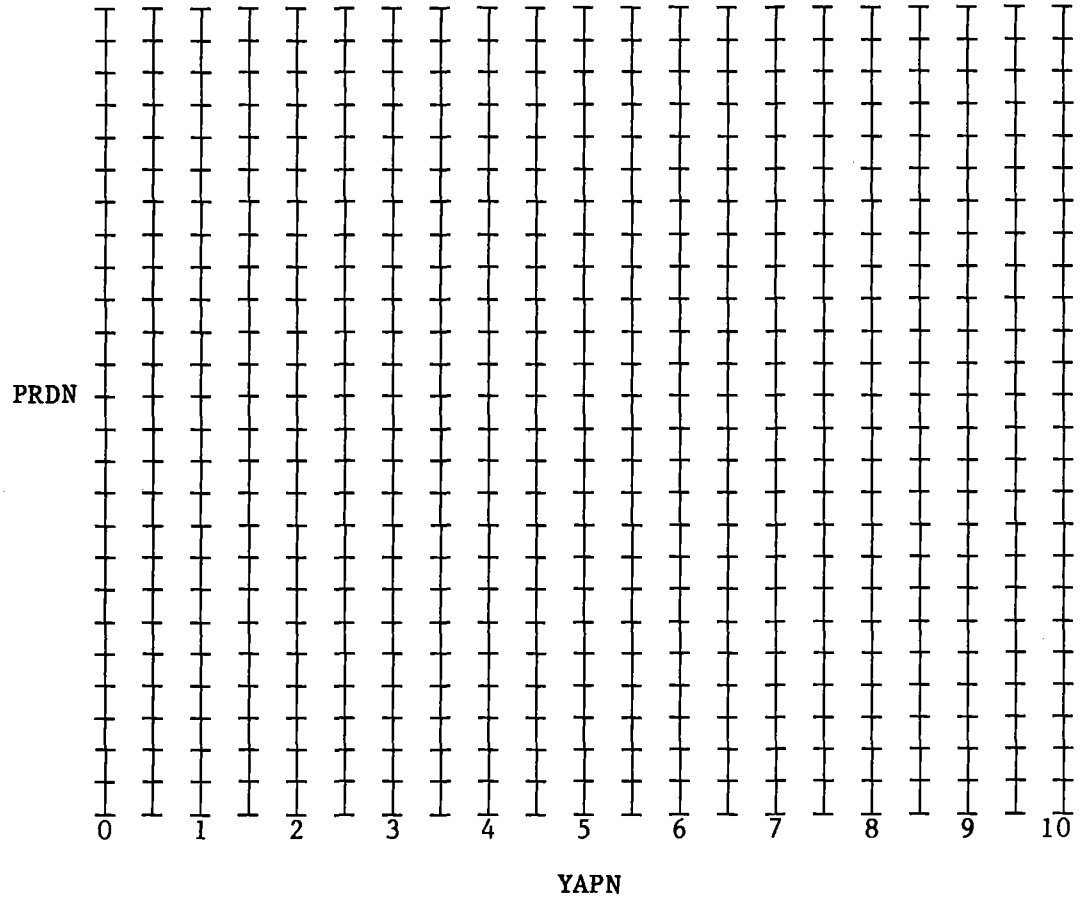
Wishart, W. 1970. When and why it is good management to shoot bighorn ewes and lambs. Trans. Northern Wild Sheep Council pp. 56-60.

_____. 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-spraying 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

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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

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