TOPIC 5. EVALUATIONS OF FACTORS AFFECTING NET POPULATION GROWTH

A large number of factors have the potential for affecting net population productivity, or the growth potential of a population over time. The effects of any one of these factors do not usually occur singly; poor nutrition may result not only in death from starvation but also increased susceptibility to hunting, winter mortality, predation, and other factors. These associative effects are difficult to assess and represent mathematically.

The several UNITS in this TOPIC provide opportunities to develop WORKSHEETS with evaluations for local conditions. Try to build feed-back relationships into the evaluations, linking winter mortality to nutritional stress as well as weather and snow accumulation effects, for example. The formats for POPULATION PREDICTIONS in TOPIC 4 will be used repeatedly; calculations in these UNITS are repetitious of basic calculations, with rates modified by the factors being evaluated.

UNIT 5.1: NUTRITION

Nutrition is a fundamental relationship between animal and range. The nutrient base determines growth rates, reproductive rates, birth weights of the young, antler sizes and weights, fat reserves, endurance, and other characteristics that are dependent on energy transactions.

One of the most important factors affecing the nutrition of wild animals is that of overpopulation, resulting in deteriorating range productivity, reduced body weights, reduced reproductive rates and higher winter mortality.

A series of analyses may be made for white-tailed deer that start with 0.0 fawn reproduction and proportional yearling and adult rates, using the equations given in UNIT 3.2. Put in terms of FARR, the equations are:

$$YERR = 1.06\ (FARR) + 1.28$$

$$ADRR = 0.38\ (FARR) + 1.78$$

Then, increase fawn reproduction to 0.2 and the yearling and adult rates proportionately. The rates are tabulated below. Repetitions of this calculation for FARR = 0.0, 0.2, and 0.4 cover the range of effects of poor nutrition, when no fawns breed, to very good nutrition, when 40% of them breed. WORKSHEETS provide opportunities for these and other evaluations.

FARR	YERR	ADRR
0.0	0.63	1.49
0.2	1.15	1.70
0.4	1.67	1.91

REFERENCES, UNIT 5.1

NUTRITION

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
AMNAA	31--3	697	743	odvi	range vegetation, texas	buechner,hk	1944
JOMAA	32--3	267	280	odvi	notes on fecundity, maine	palmer,rs	1951
JWMAA	11--4	317	323	odvi	die-offs, edwrds plat, tex	taylor,wp; hahn,h	1947
JWMAA	12--1	78	86	odvi	product, yield, george res	o'roke,ec; hamers	1948
JWMAA	15--1	73	80	odvi	product, mortali, coralled	severinghaus,cw	1951
JWMAA	21--2	245	247	odvi	marsh deer die-off, louisi	glasgow,ll; ensmi	1957
JWMAA	29--1	74	79	odvi	reprod study on penned wtd	verme,lj	1965
JWMAA	29--4	706	716	odvi	a die-off in w-t deer, tex	marburger,rg; tho	1965
JWMAA	32--1	130	141	odvi	rang use, food, cons, prod	allen,eo	1968
JWMAA	33--4	881	887	odvi	reproduction, plane nutrit	verme,lj	1969
NAWTA	15---	170	190	odvi	variatn fertil, rnge conds	cheatum,el; sever	1950
NFGJA	11--1	13	27	odvi	product, growth, adirondac	severinghaus,cw;/	1964
PCGFA	8----	83	85	odvi	deer vs livest, gulf coast	goodrum,pd; reid,	1954
PCGFA	13---	62	69	odvi	mast abund, weight, reprod	harlow,rf; tyson,	1959
WVAFA	6---1	2	4	odvi	forg prod deter deer numb?	towry,r	1975

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
CAFGA	38--2	211	224	odhe	food hab, prod, cond, cali	lassen,rw; ferre/	1952
CAFGA	39	177	186	odhe	reprod, 3 chapar cov types	taber,rd	1953
CAFGA	40--3	215	234	odhe	de fora relat lassen-washo	dasmann,w; blaisd	1954
CAFGA	44--3	253	259	odhe	producti, calif deer herds	bischoff,ai	1958
JWMAA	19--1	115	136	odhe	fertility, utah mule deer	robinette,wl; ga/	1955
JWMAA	19--4	503	503	odhe	rocky mountain, high repro	jensen,w; robine/	1955
JWMAA	41--4	785	789	odhe	resp to fire, clea-cu, wyo	davis,pr	1977
NAWTA	9----	156	161	odhe	productivity, central utah	robinette,wl; ols	1944
NAWTA	15---	589	596	odhe	productiv, mule d, colorad	tolman,cd	1950
NAWTA	21---	159	172	odhe	nutr, pop dyn, n coast cal	taber,rd	1956

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
JWMAA	17--2	177	184	ceel	reproduction, yellowstone	kittams,wh	1953
NAWTA	20---	560	567	ceel	increas natal, lowered pop	buechner,hk; swan	1955

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
JWMAA	22--3	261	268	alal	reproductn in a population	edwards,ry; ritce	1958
JWMAA	23--4	381	401	alal	reprod & produc, newfoundl	pimlott,dh	1959

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
CAFGA	36--3	328	329	anam	calif reproduct potentials	chattin,je; lasse	1950
JWMAA	34--3	570	582	anam	forag use, prod, water con	beale,dm; smith,a	1970

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
AMNTA	100--	687	690		nat selec, costs of reprod	williams,gc	1966

CHAPTER 19, WORKSHEET 5.1a

Population changes in a population of 100 deer on poor to good ranges

Differences in net population growth may be evaluated by completing the following tabulations, determining the b values for mortality and natality, and completing the exponential calculations.

Complete the tabulations below and plot the results on the grid on the next page. Note that yearling and adult reproductive rates are proportional to fawn reproductive rates (See the equations on page 57).

A constant mortality rate of 0.20 used, demonstrating the effects of variations in reproductive rates due to range conditions.

AGE CLASSES	ACYI	NUAC	MTRT	x	FRPA	=	MWMA
ACa-. & ACaa.	0-1	47	____	x	____	=	____
ACb-. & ACbb.	1-2	36	____	x	____	=	____
ACc-. & ACcc.	2-3+	17	____	x	____	=	____

SUMS = [100]= TNAP [1.00] [____] = WMTP

* * * * *

AGE CLASSES	ACYI	NUAC	RPRT	x	FRPA	=	WRAC
ACa-. & ACaa.	0-1	47	0.00	x	____	=	____
ACb-. & ACbb.	1-2	36	0.63	x	____	=	____
ACc-. & ACcc.	2-3+	17	1.49	x	____	=	____

SUMS = [100]= TNAP [1.00] [____] = WRTP

* * * * *

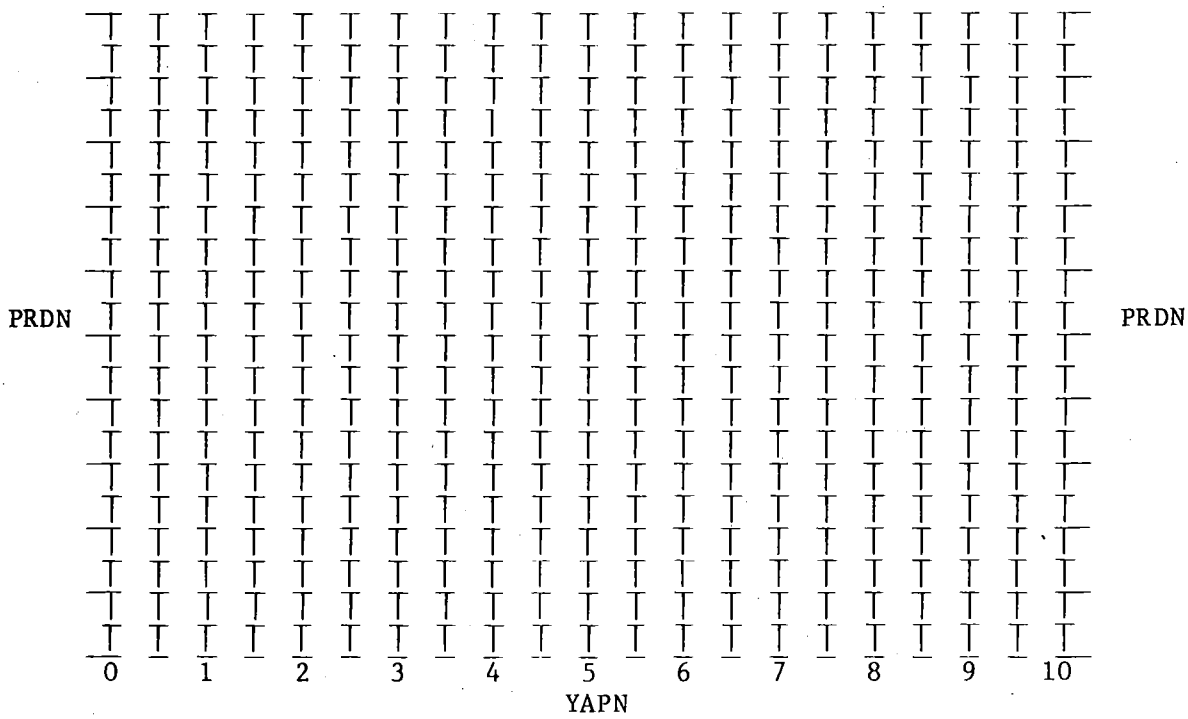
AGE CLASSES	ACYI	NUAC	RPRT	x	FRPA	=	WRAC
ACa-. & ACaa.	0-1	47	0.20	x	____	=	____
ACb-. & ACbb.	1-2	36	1.15	x	____	=	____
ACc-. & ACcc.	2-3+	17	1.70	x	____	=	____

SUMS = [100]= TNAP [1.00] [____] = WRTP

AGE CLASSES	ACYI	NUAC	RPRT	x	FRPA	=	WRAC
ACa-. & ACaa.	0-1	47	0.40	x	____	=	____
ACb-. & ACbb.	1-2	36	1.67	x	____	=	____
ACc-. & ACcc.	2-3+	17	1.91	x	____	=	____

SUMS = [100]= TNAP [1.00] [____] = WRTP

* * * * *



UNIT 5.2: HUNTING

Regulated hunting offers many opportunities for regulating net population productivity. Changes in population trends may be directed by selective hunting by sex (or for most species, antlered and anterless animals), and by regulating the total number that can be removed. Generally speaking, most agencies responsible for maintaining stable ruminant populations use both of these two options in their management programs.

Management options are discussed in CHAPTERS 21 and 22. Carrying capacities are discussed in CHAPTER 20. Here in this UNIT 5.2, the effects of hunting, or mortality during a selected time period, may be evaluated.

It is suggested that female reproductive rates be maintained at constant levels while the effects of sex selection options and different rates of removal of antlerless deer are evaluated in the WORKSHEETs that follow. The sequence might be for recruitment rates of 0.20, 0.63, and 1.49 for fawns, yearlings, and adults respectively, be used, with 0, 0.20 . . . 0.80 mortality rates (at 0.20 increments) for males (antlered) only. Then, add female (antlerless) mortality rates due to hunting of 1/4, 1/2, 3/4, and 1/1 of the male (antlered) rates. Such combinations will result in an array of values that will provide a useful visual display when plotted.

Other WORKSHEETS may be derived for species and conditions of your choice. The tabulation of the data is time-consuming. Once weighted mean population rates are determined, the exponential calculation is easily and quickly made.

REFERENCES, UNIT 5.2

HUNTING

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
JWMAA	29--2	366	370	od--	primev hunt press, indians	elder,wh	1965

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
CNSVA	18--4	10	11	odvi	demnd, suppl, party permts	parker,sr	1964
HMECA	4---4	331	349	odvi	garden huntng, amer tropcs	linares,of	1976
JWMAA	5---3	333	336	odvi	trends, kill, bucks, wisco	schunke,wh; bussi	1941
JWMAA	11--4	317	323	odvi	die-offs, edward plat, tex	taylor,wp; hahn,h	1947
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	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
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
NFGJA	10--2	186	193	odvi	eff archry in contrl abund	severinghaus,cw	1963
NOSCA	47--4	250	255	odvi	hunting success, idaho dee	will,gc	1973
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
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
WLSBA	7---1	10	16	odvi	hunter-inflicted wounding	stormer,fa; kirk/	1979
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	21-12	3	9	odvi	new deal for deer & hunter	keener,jm	1956
WSCBA	23-10	13	17	odvi	less waste in the woods	deboer,sg	1958

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
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
BIOMA	29--4	801	809	ceel	optim age specif harv, pop	beddington,jr; t	1973
JWMAA	24--1	15	21	ceel	on afognak island, alaska	troyer,aw	1960

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
AVSPA	57---	1	18	rata	topograph anatomy, hunting	engebretsen,rh	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
				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---------- AUTHORW---------- YEAR

oram

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

JWMAA 12--3	236	240	wldl	meth contr publ hunt, n am	scott,we	1948
JWMAA 40--3	517	522	many	iden hemoglob, law enforce	bunch,td; meadow/	1976
NAWTA 14---	410	423		huntng stats, 1936 vs 1946	ludy,d	1949
NAWTA 22---	544	569	biga	eff hunt, cont pop in n am	longhurst,wm	1957
NPKMA 35---	4	6	wldl	wildl pop control & hunter	cowles,rb	1961
TWASA 53A--	57	65	wldl	aspcts of wldl & hunt, wis	mccabe,ra	1964

CHAPTER 19, WORKSHEET 5.2a

Net population changes in a population of 100 deer
with a mortality rate of 0.00

This WORKSHEET is one of a series demonstrating the effects of mortality rates of 0, 0.20, 0.40, 0.60, and 0.80 on net population change.

The recruitment rates (RCRT) of 0.15, 0.90, and 1.30 are calculated for fawn, yearling, and adult age classes, respectively, and the weighted mean recruitment rate for the population (WRCP) determined. These rates are used in all of the WORKSHEETS in this series.

AGE CLASSES	ACYI	NUAC	MTRT	x	FRPA	=	MWMA
ACa-. & ACaa.	0-1	47	0.00	x	____	=	____
ACb-. & ACbb.	1-2	36	0.00	x	____	=	____
ACc-. & ACcc.	2-3+	17	0.00	x	____	=	____

SUMS = [100]= TNAP [1.00] [____] = WMTP
____ = bMTR

AGE CLASSES	ACYI	NUAC	RCRT	x	FRPA	=	WRCA
ACa-. & ACaa.	0-1	47	0.15	x	____	=	____
ACb-. & ACbb.	1-2	36	0.90	x	____	=	____
ACc-. & ACcc.	2-3+	17	1.30	x	____	=	____

SUMS = [100]= TNAP [1.00] [____] = WRCP
____ = bRCR

bMTR _____ + bRCR _____ = bPOP = _____

$$PRDN = 100\ e^{(\_\_\_\_\_)(YAPN)} = \_\_\_\_\_.$$

If YAPN = 1, PRDN =

If YAPN = 2, PRDN =

If YAPN = 3, PRDN =

If YAPN = 4, PRDN =

If YAPN = 5, PRDN =

CHAPTER 19, WORKSHEET 5.2b

Net population changes in a population of 100 deer
with a mortality rate of 0.20

This WORKSHEET is one of a series demonstrating the effects of mortality rates of 0, 0.20, 0.40, 0.60, and 0.80 on net population change.

The recruitment rates (RCRT) of 0.15, 0.90, and 1.30 are calculated for fawn, yearling, and adult age classes, respectively, and the weighted mean recruitment rate for the population (WRCP) determined. These rates are used in all of the WORKSHEETS in this series.

AGE CLASSES	ACYI	NUAC	MTRT	x	FRPA	=	MWMA
ACa-. & ACaa.	0-1	47	0.20	x	____	=	____
ACb-. & ACbb.	1-2	36	0.20	x	____	=	____
ACc-. & ACcc.	2-3+	17	0.20	x	____	=	____

SUMS = [100]= TNAP [1.00] [____] = WMTP
____ = bMTR

AGE CLASSES	ACYI	NUAC	RCRT	x	FRPA	=	WRCA
ACa-. & ACaa.	0-1	47	0.15	x	____	=	____
ACb-. & ACbb.	1-2	36	0.90	x	____	=	____
ACc-. & ACcc.	2-3+	17	1.30	x	____	=	____

SUMS = [100]= TNAP [1.00] [____] = WRCP
____ = bRCR

bMTR _____ + bRCR _____ = bPOP = _____

$$PRDN = 100\ e^{(\_\_\_\_\_)(YAPN)} = \_\_\_\_\_.$$

If YAPN = 1, PRDN =

If YAPN = 2, PRDN =

If YAPN = 3, PRDN =

If YAPN = 4, PRDN =

If YAPN = 5, PRDN =

CHAPTER 19, WORKSHEET 5.2c

Net population changes in a population of 100 deer
with a mortality rate of 0.40

This WORKSHEET is one of a series demonstrating the effects of mortality rates of 0, 0.20, 0.40, 0.60, and 0.80 on net population change.

The recruitment rates (RCRT) of 0.15, 0.90, and 1.30 are calculated for fawn, yearling, and adult age classes, respectively, and the weighted mean recruitment rate for the population (WRCP) determined. These rates are used in all of the WORKSHEETS in this series.

AGE CLASSES	ACYI	NUAC	MTRT	x	FRPA	=	MWMA
ACa-. & ACaa.	0-1	47	0.40	x	____	=	____
ACb-. & ACbb.	1-2	36	0.40	x	____	=	____
ACc-. & ACcc.	2-3+	17	0.40	x	____	=	____

SUMS = [100]= TNAP [1.00] [____] = WMTP
____ = bMTR

AGE CLASSES	ACYI	NUAC	RCRT	x	FRPA	=	WRCA
ACa-. & ACaa.	0-1	47	0.15	x	____	=	____
ACb-. & ACbb.	1-2	36	0.90	x	____	=	____
ACc-. & ACcc.	2-3+	17	1.30	x	____	=	____

SUMS = [100]= TNAP [1.00] [____] = WRCP
____ = bRCR

bMTR _____ + bRCR _____ = bPOP = _____

PRDN = 100 $e^{(\_\_\_\_\_)(YAPN)}$ = _____.

If YAPN = 1, PRDN =

If YAPN = 2, PRDN =

If YAPN = 3, PRDN =

If YAPN = 4, PRDN =

If YAPN = 5, PRDN =

CHAPTER 19, WORKSHEET 5.2d

Net population changes in a population of 100 deer
with a mortality rate of 0.60

This WORKSHEET is one of a series demonstrating the effects of mortality rates of 0, 0.20, 0.40, 0.60, and 0.80 on net population change.

The recruitment rates (RCRT) of 0.15, 0.90, and 1.30 are calculated for fawn, yearling, and adult age classes, respectively, and the weighted mean recruitment rate for the population (WRCP) determined. These rates are used in all of the WORKSHEETS in this series.

AGE CLASSES	ACYI	NUAC	MTRT	x	FRPA	=	MWMA
ACa-. & ACaa.	0-1	47	0.60	x	____	=	____
ACb-. & ACbb.	1-2	36	0.60	x	____	=	____
ACc-. & ACcc.	2-3+	17	0.60	x	____	=	____

SUMS = [100]= TNAP [1.00] [____] = WMTP
____ = bMTR

AGE CLASSES	ACYI	NUAC	RCRT	x	FRPA	=	WRCA
ACa-. & ACaa.	0-1	47	0.15	x	____	=	____
ACb-. & ACbb.	1-2	36	0.90	x	____	=	____
ACc-. & ACcc.	2-3+	17	1.30	x	____	=	____

SUMS = [100]= TNAP [1.00] [____] = WRCP
____ = bRCR

bMTR _____ + bRCR _____ = bPOP = _____

PRDN = 100 $e^{(\_\_\_\_\_)(YAPN)}$ = _____.

If YAPN = 1, PRDN =

If YAPN = 2, PRDN =

If YAPN = 3, PRDN =

If YAPN = 4, PRDN =

If YAPN = 5, PRDN =

CHAPTER 19, WORKSHEET 5.2e

Net population changes in a population of 100 deer
with a mortality rate of 0.80

This WORKSHEET is one of a series demonstrating the effects of mortality rates of 0, 0.20, 0.40, 0.60, and 0.80 on net population change.

The recruitment rates (RCRT) of 0.15, 0.90, and 1.30 are calculated for fawn, yearling, and adult age classes, respectively, and the weighted mean recruitment rate for the population (WRCP) determined. These rates are used in all of the WORKSHEETS in this series.

AGE CLASSES	ACYI	NUAC	MTRT	x	FRPA	=	MWMA
ACa-. & ACaa.	0-1	47	0.80	x	____	=	____
ACb-. & ACbb.	1-2	36	0.80	x	____	=	____
ACc-. & ACcc.	2-3+	17	0.80	x	____	=	____

SUMS = [100]= TNAP [1.00] [____] = WMTP
____ = bMTR

AGE CLASSES	ACYI	NUAC	RCRT	x	FRPA	=	WRCA
ACa-. & ACaa.	0-1	47	0.15	x	____	=	____
ACb-. & ACbb.	1-2	36	0.90	x	____	=	____
ACc-. & ACcc.	2-3+	17	1.30	x	____	=	____

SUMS = [100]= TNAP [1.00] [____] = WRCP
____ = bRCR

bMTR _____ + bRCR _____ = bPOP = _____

$$PRDN = 100\ e^{(\_\_\_\_\_)(YAPN)} = \_\_\_\_\_.$$

If YAPN = 1, PRDN =

If YAPN = 2, PRDN =

If YAPN = 3, PRDN =

If YAPN = 4, PRDN =

If YAPN = 5, PRDN =

Plot the results of all 5 of these calculations (5.1a-5.1e) on the grid on the next page. Label each curve with the applicable mortality rate.

PRDN

0 1 2 3 4 5

YAPN

UNIT 5.3: WINTER MORTALITY

Winter mortality results when weather and snow conditions place the animals on the range in a negative energy balance for too long a time (see CHAPTER 17). The negative energy balance may be due to hypothermia as a result of cold weather, and to the cost of activity as a result of snow accumulations. Cold weather and deep snow both make conditions even worse for that animal than either alone. Further, continued cold weather perpetuates continued snow accumulations, and the combined effect which results in continued deep accumulations is most detrimental because of the difficulty in obtaining forage.

The amount of fat reserve is a very important factor affecting the amount of winter mortality that may occur. Seasonal weight rhythms discussed in CHAPTER 1 are a natural adaptation to the changing quantities and quality of resources. Peak fall weights occur in response to peak amounts of fat accumulations (CHAPTER 2), and these two rhythms in body weight and body composition are integral parts of survival in the winter.

The effects of winter mortality on net population productivity demonstrate the effects of age specific mortality. In white-tailed deer, fawns are most likely to succumb, as expected. Their lighter weights and the lower fat composition of their bodies simply means they have fewer reserves to live on than older and larger animals. Older animals past their prime are the next likely group to succumb. Thus a WORKSHEET evaluation using reproductive rates of 0.20, 0.63, and 1.49 for fawns, yearlings, and adults and differential mortality rates for these three groups will indicate potential effects of winter mortality on the population. Fawn mortality rates of 0, 0.20, 0.40 . . . 0.80 (at 0.20 intervals) might be accompanied by adult rates that are 1/5 and yearling rates that are 1/10 of the fawn rates. Other combinations may also be tried, of course; WORKSHEET possibilities are indeed many. After evaluating the effects of winter mortality in this UNIT and of nutrition and hunting in the two previous UNITS, the possibilities for combining these effects becomes evident. The results from calculations in the UNITS in this TOPIC 5 should be combined into evaluations for management discussions in CHAPTERS 20, 21, and 22.

REFERENCES, UNIT 5.3

WINTER MORTALITY

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
AMFOA	51--1	13	15	od--	killing deer by kindness	carhart,ah	1945

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
JWMAA	2---1	1	2	odvi	preventing deer concentrat	cox,wt	1938
JWMAA	6---1	27	30	odvi	deer of allegany state prk	shadle,ar; stullk	1942
JWMAA	11--2	162	177	odvi	surv, over-popul deer rang	leopold,a; sowls/	1947
JWMAA	18--4	482	495	odvi	deer management study: mud	hunt,rw; mangus,l	1954
JWMAA	35--1	47	56	odvi	mort, young fawns, s texas	cook,rs; white,m/	1971
MRYCA	17--1	13	14	odvi	kill of deer in maryland	anonymous	1939
NAWTA	12---	212	223	odvi	weather, wint mort, adiron	severinghaus,cw	1947
NAWTA	15---	170	190	odvi	variatn fertil, rnge conds	cheatum,el; sever	1950
NAWTA	21---	555	566	odvi	larg-scale dead dee survey	whitlock,sc; eber	1956
NFGJA	8---1	61	63	odvi	metho, det kill freq/sq mi	severinghaus,cw	1961
PMACA	46...	277	287	odvi	winter mortality, michigan	blouch,ri	1961
WSCBA	11--7	6	10	odvi	deer as an outdoor problem	swift,e	1946
WSCBA	14--6	1	4	odvi	winter deer range conditns	dahlberg,bl	1949

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
CAFGA	40--3	215	234	odhe	de fora relat lassen-washo	dasmann,w; blaisd	1954
JWMAA	3---4	295	306	odhe	n yellowst wint range stud	grimm,rl	1939
JWMAA	24--1	80	88	odhe	nat mortal, deer, se alask	klein,dr; olson,s	1960

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
JWMAA	40--2	336	339	alal	marrw fat femr, rel mortal	franzmann,aw; arn	1976

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
JWMAA	37--3	343	352	anam	mort, prongh fawns, w utah	beale,dm; smith,a	1973

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
AMNTA	11-10	624	624	bibi	northrn range of the bison	allen,ja	1877

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
JWMAA	38--4	771	774	ovca	lamb prod surv, mort, colo	woodard,tn; guti/	1974

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	159	168		many snow depths & ungul abunda	edwards,ry	1956
XFWLA	283..				biga big game inventory, u s	anonymous	1943
XFWLA	303..				biga big game inventory, u s	anonymous	1946
XFWLA	321..				biga big game inventory, u s	anonymous	1949

OTHER PUBLICATIONS

Proceedings of the Snow and Ice in Relation to Wildlife and Recreation Symposium.

CHAPTER 19, WORKSHEET 5.3a

The effects of winter mortality rates of 0.00 for fawns, 0.00 for yearlings and 0.00 for adults on net population growth of white-tailed deer

The effects of winter mortality rates of 0.00, 0.20, 0.40, 0.60, and 0.80 of fawns and 1/20 and 1/10 of these rates for yearlings and adults respectively may be illustrated by completing the calculations in this series of WORKSHEETS. The recruitment rates are 0.15, 0.90, and 1.30 for fawns, yearlings, and adults, respectively. The weighted mean recruitment rate (WRCP) is then used to determine bRCR.

AGE CLASSES	ACYI	NUAC	MTRT	x	FRPA	=	MWMA
ACa-. & ACaa.	0-1	47	0.00	x	____	=	____
ACb-. & ACbb.	1-2	36	0.00	x	____	=	____
ACc-. & ACcc.	2-3+	17	0.00	x	____	=	____

SUMS = [100]= TNAP [1.00] [____] = WMTP
____ = bMTR

* * * * *

AGE CLASSES	ACYI	NUAC	RCRT	x	FRPA	=	WRCA
ACa-. & ACaa.	0-1	47	0.15	x	____	=	____
ACb-. & ACbb.	1-2	36	0.90	x	____	=	____
ACc-. & ACcc.	2-3+	17	1.30	x	____	=	____

SUMS = [100]= TNAP [1.00] [____] = WRCP
____ = bRCR

bMTR _____ + bRCR _____ = bPOP = _____

$$PRDN = 100\ e^{(\_\_\_\_\_)(YAPN)} = \_\_\_\_\_.$$

If YAPN = 1, PRDN =

If YAPN = 2, PRDN =

If YAPN = 3, PRDN =

If YAPN = 4, PRDN =

If YAPN = 5, PRDN =

CHAPTER 19, WORKSHEET 5.3b

The effects of winter mortality rates of 0.20 for fawns, 0.01 for yearlings and 0.02 for adults on net population growth of white-tailed deer

The effects of winter mortality rates of 0.00, 0.20, 0.40, 0.60, and 0.80 of fawns and 1/20 and 1/10 of these rates for yearlings and adults respectively may be illustrated by completing the calculations in this series of WORKSHEETS. The recruitment rates are 0.15, 0.90, and 1.30 for fawns, yearlings, and adults, respectively. The weighted mean recruitment rate (WRCP) is then used to determine bRCR.

AGE CLASSES	ACYI	NUAC	MTRT	x	FRPA	=	MWMA
ACa-. & ACaa.	0-1	47	0.20	x	____	=	____
ACb-. & ACbb.	1-2	36	0.01	x	____	=	____
ACc-. & ACcc.	2-3+	17	0.01	x	____	=	____

SUMS = [100]= TNAP [1.00] [____] = WMTP
____ = bMTR

* * * * *

AGE CLASSES	ACYI	NUAC	RCRT	x	FRPA	=	WRCA
ACa-. & ACaa.	0-1	47	0.15	x	____	=	____
ACb-. & ACbb.	1-2	36	0.90	x	____	=	____
ACc-. & ACcc.	2-3+	17	1.30	x	____	=	____

SUMS = [100]= TNAP [1.00] [____] = WRCP
____ = bRCR

bMTR _____ + bRCR _____ = bPOP = _____

$$PRDN = 100\ e^{(\_\_\_\_\_)(YAPN)} = \_\_\_\_\_.$$

If YAPN = 1, PRDN =

If YAPN = 2, PRDN =

If YAPN = 3, PRDN =

If YAPN = 4, PRDN =

If YAPN = 5, PRDN =

The effects of winter mortality rates of 0.04 for fawns, 0.02 for yearlings and 0.04 for adults on net population growth of white-tailed deer

The effects of winter mortality rates of 0.00, 0.20, 0.40, 0.60, and 0.80 of fawns and 1/20 and 1/10 of these rates for yearlings and adults respectively may be illustrated by completing the calculations in this series of WORKSHEETS. The recruitment rates are 0.15, 0.90, and 1.30 for fawns, yearlings, and adults, respectively. The weighted mean recruitment rate (WRCP) is then used to determine bRCR.

AGE CLASSES	ACYI	NUAC	MTRT	x	FRPA	=	MWMA
ACa-. & ACaa.	0-1	47	0.40	x	____	=	____
ACb-. & ACbb.	1-2	36	0.02	x	____	=	____
ACc-. & ACcc.	2-3+	17	0.04	x	____	=	____

SUMS = [100]= TNAP [1.00] [____] = WMTP
____ = bMTR

* * * * *

AGE CLASSES	ACYI	NUAC	RCRT	x	FRPA	=	WRCA
ACa-. & ACaa.	0-1	47	0.15	x	____	=	____
ACb-. & ACbb.	1-2	36	0.90	x	____	=	____
ACc-. & ACcc.	2-3+	17	1.30	x	____	=	____

SUMS = [100]= TNAP [1.00] [____] = WRCP
____ = bRCR

bMTR ____ ____ + bRCR _____ = bPOP = _____

PRDN = 100 $e^{(\_\_\_\_\_)(YAPN)}$ = _____.

If YAPN = 1, PRDN =

If YAPN = 2, PRDN =

If YAPN = 3, PRDN =

If YAPN = 4, PRDN =

If YAPN = 5, PRDN =

CHAPTER 19, WORKSHEET 5.3d

The effects of winter mortality rates of 0.60 for fawns, 0.03 for yearlings and 0.06 for adults on net population growth of white-tailed deer

The effects of winter mortality rates of 0.00, 0.20, 0.40, 0.60, and 0.80 of fawns and 1/20 and 1/10 of these rates for yearlings and adults respectively may be illustrated by completing the calculations in this series of WORKSHEETS. The recruitment rates are 0.15, 0.90, and 1.30 for fawns, yearlings, and adults, respectively. The weighted mean recruitment rate (WRCP) is then used to determine bRCR.

AGE CLASSES	ACYI	NUAC	MTRT	x	FRPA	=	MWMA
ACa-. & ACaa.	0-1	47	0.60	x	____	=	____
ACb-. & ACbb.	1-2	36	0.03	x	____	=	____
ACc-. & ACcc.	2-3+	17	0.06	x	____	=	____

SUMS = [100]= TNAP [1.00] [____] = WMTP
____ = bMTR

* * * * *

AGE CLASSES	ACYI	NUAC	RCRT	x	FRPA	=	WRCA
ACa-. & ACaa.	0-1	47	0.15	x	____	=	____
ACb-. & ACbb.	1-2	36	0.90	x	____	=	____
ACc-. & ACcc.	2-3+	17	1.30	x	____	=	____

SUMS = [100]= TNAP [1.00] [____] = WRCP
____ = bRCR

bMTR _____ + bRCR _____ = bPOP = _____

PRDN = 100 $e^{(\_\_\_\_\_)(YAPN)}$ = _____.

If YAPN = 1, PRDN =

If YAPN = 2, PRDN =

If YAPN = 3, PRDN =

If YAPN = 4, PRDN =

If YAPN = 5, PRDN =

The effects of winter mortality rates of 0.80 for fawns, 0.04 for yearlings and 0.08 for adults on net population growth of white-tailed deer

The effects of winter mortality rates of 0.00, 0.20, 0.40, 0.60, and 0.80 of fawns and 1/20 and 1/10 of these rates for yearlings and adults respectively may be illustrated by completing the calculations in this series of WORKSHEETS. The recruitment rates are 0.15, 0.90, and 1.30 for fawns, yearlings, and adults, respectively. The weighted mean recruitment rate (WRCP) is then used to determine bRCR.

AGE CLASSES	ACYI	NUAC	MTRT	x	FRPA	=	MWMA
ACa-. & ACaa.	0-1	47	0.80	x	____	=	____
ACb-. & ACbb.	1-2	36	0.04	x	____	=	____
ACc-. & ACcc.	2-3+	17	0.08	x	____	=	____

SUMS = [100]= TNAP [1.00] [____] = WMTP
____ = bMTR

AGE CLASSES	ACYI	NUAC	RCRT	x	FRPA	=	WRCA
ACa-. & ACaa.	0-1	47	0.15	x	____	=	____
ACb-. & ACbb.	1-2	36	0.90	x	____	=	____
ACc-. & ACcc.	2-3+	17	1.30	x	____	=	____

SUMS = [100]= TNAP [1.00] [____] = WRCP
____ = bRCR

bMTR _____ + bRCR _____ = bPOP = _____

PRDN = 100 $e^{(\_\_\_\_\_)(YAPN)}$ = _____.

If YAPN = 1, PRDN =

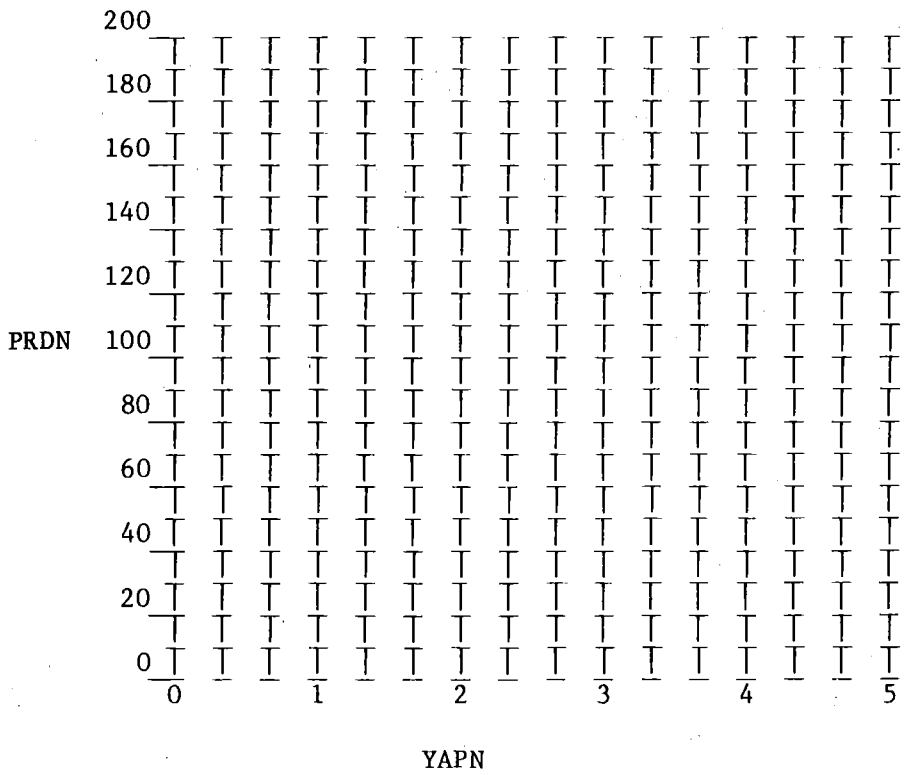
If YAPN = 2, PRDN =

If YAPN = 3, PRDN =

If YAPN = 4, PRDN =

If YAPN = 5, PRDN =

Plot the results of all 5 of these calculations (5.3a-5.3e) on the grid on the next page. Label each curve with the applicable mortality rate.


PRDN
200
180
160
140
120
100
80
60
40
20
0
0
1
2
3
4
5
YAPN

UNIT 5.4: PREDATION

Evaluations of the effects of predation on net population productivity direct ones attention to differential mortality between ages and time of year. Mortality of all species can be very high in the neonates, with wide ranges in mortality rates as a result of weather conditions and predation levels. Predators of wild ruminants appear to be more efficient in killing the very young and the very old than the animals in the ages between these tow extremes. References to many studies of predation by a variety of predators are listed in the SERIALS list, providing many options for evaluating the effects of predation in the WORKSHEETS.

Select predator studies that include dates of age-specific rates throughout the year, resulting in evaluations that indicate changes in populations through the seasons.

REFERENCES, UNIT 5.4

PREDATION

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
BJDIA	47...	131	137	odvi	patt wolf pack move, kills	frijlink,jh	1977
CAFNA	91--1	28	40	odvi	stat, habi, cougar, manito	nero,rw; wrigley,	1977
CAFNA	92--1	91	94	odvi	seas var food, wolves, ont	theberge,jb; oos/	1978
CJZOA	56--5	1207	1210	odvi	fawn, heart rate,wolf howl	moen,an; dellafe/	1978
JOMAA	26--4	439	440	odvi	wildcat predation on deer	smith,be	1945
JOMAA	29--1	69	70	odvi	bobcats kill deer, pennsyl	matson,jr	1948
JOMAA	43--3	430	431	odvi	bobcat mort, predati on de	petraborg,wh; gun	1962
JOMAA	54--1	291	293	odvi	desc of remains, kill, coy	white,m	1973
JOMAA	56--1	44	63	odvi	wt, grow, surv, wolf, minn	van ballenberghe/	1975
JWMAA	3---2	99	103	odvi	fall, wint foods, bobc, vt	hamilton,wj,jr; /	1939
JWMAA	6---4	328	337	odvi	wint relat, bobcats, maine	marston,ma	1942
JWMAA	9---2	131	145	odvi	habits, foods, bobca, minn	rollings,ct	1945
JWMAA	20--2	199	200	odvi	foods eaten by bobc, maine	westfall,cz	1956
JWMAA	22--1	184	192	odvi	mobility, misso deer, dogs	progulske,dr; ba	1958
JWMAA	35--2	707	716	odvi	respon, deer, hunting dogs	sweeney,jr; mar/	1971
JWMAA	36--2	357	369	odvi	wolf pred, winter, ontario	kolenosky,gb	1972
JWMAA	37--3	253	265	odvi	ecolog, feral dogs, alabam	scott,md; causey	1973
JWMAA	38--4	854	859	odvi	relat, pred remov, product	beasom,sl	1974

odvi continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
JWMAA	40--2	365	368	odvi	energ utiliza, 3 fox diets	litvaitis,ja; ma	1976
JWMAA	40--3	429	441	odvi	deer migration, wolf preda	hoskinson,rl; me	1976
JWMAA	40--4	663	668	odvi	chang, wolf summ foods,ont	voigt,dr; kolen/	1976
JWMAA	41--1	63	69	odvi	neonatal fawn survi, texas	carroll,bk; brown	1977
NAWTA	3----	302	304	odvi	relat, predat, glac nat pk	aiton,jf	1938
NOSCA	45--4	213	218	odvi	pred-prey relatio, coyotes	ogle,tf	1971
PCGFA	25---	69	77	odvi	effe dogs, on radioed deer	corbett,rl; marc/	1972
SCIEA	4314-	320	321	odvi	wolf, buff zone, prey rese	mech,ld	1977
SWNAA	12...	156	162	odvi	behav interact, other mamm	michael,ed	1967
SWNAA	21--4	451	457	odvi	bobcat resp, chan prey abu	beasom,sl; moore,	1977
WLSBA	4---3	128	129	odvi	flush distan, mode of trav	kucera,e	1976
WSCBA	8---8	3	11	odvi	deer irruptions	leopold,a	1943
XFNCA	52---	1	62	odvi	age, sex, cond, wolf kills	mech,ld; frenzel,	1971
XFNCA	148--	1	23	odvi	role wolf, deer decl, minn	mech,ld; karns,pd	1977

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
GRBNA	37--1	101	102	odhe	infl, pred contr, wint her	austin,dd; urnes/	1977
JOMAA	28--1	63	63	odhe	bobcat preys on deer	dill,hh	1947
JOMAA	53--2	393	394	odhe	resp yng deer to pred odor	muller-schwarze,	1972
JWMAA	31--3	496	501	odhe	anam, pred by golden eagle	mcgahan,j	1967
JWMAA	35--2	378	381	odhe	alal, win food, cougar, bc	spalding,dj; leso	1971
JWMAA	41--3	576	578	odhe	ceel, food hab, cougar, or	toweill,de; mesls	1977
JWMAA	43--4	956	958	odhe	coyote predation on fawns	truett,jc	1979
SWNAA	23--1	152	153	odhe	summer foods, coyote, colo	ribic,ca	1978
UTSCB	36...	87	90	odhe	coyotes and deer	nielsen,db	1975
WLMOA	21---	1	39	odhe	ceel, mt lion preda, idaho	hornocker,mg	1970
WLMOA	35---	1	60	odhe	ceel, mt lion soc org, ida	seidensticker,jc/	1973

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
JOMAA	46--3	498	498	ceel	calf pursued, coyote, mich	moran,rj; ozoga,j	1965
JOMAA	52--1	199	202	ceel	pred, blac bear on mal elk	barmore,wj; strad	1971
JWMAA	24--1	15	21	ceel	on afognak island, alaska	troyer,aw	1960
JWMAA	36--2	556	561	ceel	grizzly bear-elk, yellowst	cole,gf	1972
WLMOA	21---	1	39	ceel	odhe, mt lion preda, idaho	hornocker,mg	1970

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
AMNAA	97--2	267	279	alal	mort patt, isle royale pop	wolfe,ml	1977
NAWTA	15---	224	234	alal	bear-moose relation, kenai	chatelain,ef	1950
NAWTA	34---	117	131	alal	summary wolf stud, s alask	rausch,ra	1969
NCANA	101-3	457	466	alal	pred, bear, wolverin, swed	haglund,b	1974
NCANA	101-3	467	479	alal	occurenc, wolf food, scats	frenzel,ld	1974
NCANA	101-3	481	492	alal	snow condit, wolf relation	peterson,ro; alle	1974
VILTA	5---6	347	361	alal	wint hab, bear, wolf, swed	haglund,b	1968

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
ALLKA	60...	51	54	rata	circle format, etholog mot	anghi,cs	1973
BPURD	1----	209	220	rata	wolf pred, barren-gr, wint	miller,dr	1975
BPURD	1----	474	497	rata	clump behav, preda, caribo	cumming,hg	1975
CAFNA	87--2	183	183	rata	misquotatio of lit on pred	kuyt,e	1973
CWRSB	21---	1	35	rata	food hab, wolves, car rang	kuyt,e	1972
JOMAA	54--2	341	348	rata	dist, densit, wolves, cana	parker,gr	1973
JOMAA	56--4	752	757	rata	diet of wolverines in norw	myhre,r; myrberge	1975
JOMAA	57--3	585		rata	surpl kill reind by wolves	bjarvall,a; nilss	1976

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
AUKJA	94--4	789	790	anam	golden eagle predation on	goodwin,ga	1977
CAFNA	84--3	301	304	anam	wint pred by eagles, coyot	bruns,eh	1970
JWMAA	13--3	313	314	anam	predation on antelope	thompson,wk	1949
JWMAA	37--3	343	352	anam	mort pronghorn fawns, utah	beale,dm; smith,a	1973
NAWTA	16---	179	193	anam	pred contr, antel manageme	arrington,n; edwa	1951
NEXRA	245--	1	12	anam	fact restr increase, n mex	howard,vw,jr; en/	1973
SWNAA	18--3	346	348	anam	golden eagle predati, fawn	tigner,jr	1973

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
CAFGA	56--3	206	207	ovca	observ interact, rep preda	weaver,ra; mensc,	1970
JWMAA	38--4	771	774	ovca	lamb prod surv, mort, colo	woodard,tn; guti/	1974

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
ATICA	23...	197	198	obmo	killing bull, single wolf	gray,dr	1970
JWMAA	35--1	103	108	obmo	pop char, jones sound, nwt	freeman,mmr	1971
MUOXD	20...	87	88	obmo	group attackd, 1 wolf, nwt	miller,fl; gunn,a	1977

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
JWMAA	40--3	400	407	dosh	sheep kill, behav, coyotes	connolly,ge; tim/	1976

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
AMNTA	97---	209	223		predator-prey interactions	rosenzweig,ml; ma	1963
AMZOA	7....	253	265		aspect, pop ecol wolv, ala		1967
AMZOA	7---2	267	278	ungu	wolf pred, ungulate popula	pimlott,dh	1967
BEHAA	35...	259	272		ontog, prey-kil beh, canid	fox,mw	1969
CNDRA	56--1	3	12		food habits, nest gold eag	carnie,sk	1954
ECOLA	56--4	855	867		pred, pry pop, gr rt, stab	tanner,jt	1975
JOMAA	33--4	429	442		trav, rang, food wolv, wis	thompson,dq	1952
JWMAA	23--3	261	273		food hab, coug, utah, neva	robinette,wl; ga/	1959
JWMAA	24--1	1	15	biga	predation on biga, e afric	wright,bs	1960
JWMAA	31--3	492	496		telemetry, study of predat	mech,ld	1967
JWMAA	42--3	528	532		wolf scat conten, prey con	floyd,tj; mech,l/	1978
NAWTA	6----	283	287		coyote-wildlf relationship	horn,ee	1941
NAWTA	39---	230	240		intensi short term removal	beasom,sl	1974
NAWTA	39---	292	300		pred-livesto probl, losses	balser,ds	1974
PASCC	15---	27	32		wolves, coronation island	merriam,hr	1964
PNASA	46--1	143	145		rela repro valu, opti pred	macarthur,rh	1960
QRBIA	21--2	144	177		predation, vertebrate popu	errington,pl	1946
WLSBA	6---1	25	32		1974 coyot harv, 17 w stat	pearson,ew	1978

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
JWMAA	26--2	133	136	caca	predation on roe d, sweden	borg,k	1962

CHAPTER 19, WORKSHEET 5.4a

The effects of different levels of mortality due to predation on net population growth

Select age-related predation and reproductive or recruitment rates from the literature and calculate their effects on net population growth using the formats below and on the next page.

AGE CLASSES	ACYI	NUAC	MTRT	x	FRPA	=	MWMA
ACa-. & ACaa.	0-1	____	____	x	____	=	____
ACb-. & ACbb.	1-2	____	____	x	____	=	____
ACc-. & ACcc.	2-3+	____	____	x	____	=	____

SUMS = [____]= TNAP [1.00] [____] = WMTP
____ = bMTR

AGE CLASSES	ACYI	NUAC	RPRT	x	FRPA	=	WRAC
ACa-. & ACaa.	0-1	____	____	x	____	=	____
ACb-. & ACbb.	1-2	____	____	x	____	=	____
ACc-. & ACcc.	2-3+	____	____	x	____	=	____

SUMS = [____]= TNAP [1.00] [____] = WRTP
____ = bRPR

bMTR ____ + bRPR ____ = bPOP = ____

$$PRDN = 100\ e^{(\_\_\_\_\_)(YAPN)} = \_\_\_\_\_.$$

If YAPN = 1, PRDN =

If YAPN = 2, PRDN =

If YAPN = 3, PRDN =

If YAPN = 4, PRDN =

If YAPN = 5, PRDN =

AGE CLASSES	ACYI	NUAC	MTRT	x	FRPA	=	MWMA
ACa-. & ACaa.	0-1	____	____	x	____	=	____
ACb-. & ACbb.	1-2	____	____	x	____	=	____
ACc-. & ACcc.	2-3+	____	____	x	____	=	____

SUMS = [____]= TNAP [1.00] [____] = WMTP
____ = bMTR

AGE CLASSES	ACYI	NUAC	RPRT	x	FRPA	=	WRAC
ACa-. & ACaa.	0-1	____	____	x	____	=	____
ACb-. & ACbb.	1-2	____	____	x	____	=	____
ACc-. & ACcc.	2-3+	____	____	x	____	=	____

SUMS = [____]= TNAP [1.00] [____] = WRTP
____ = bRPR

bMTR ____ + bRPR ____ = bPOP = ____

PRDN = 100 $e^{(\_\_\_\_\_)(YAPN)}$ = _____.

If YAPN = 1, PRDN =
If YAPN = 2, PRDN =
If YAPN = 3, PRDN =
If YAPN = 4, PRDN =
If YAPN = 5, PRDN =

* * * * * * * * * * * * * * * * * *

AGE CLASSES	ACYI	NUAC	MTRT	x	FRPA	=	MWMA
ACa-. & ACaa.	0-1	____	____	x	____	=	____
ACb-. & ACbb.	1-2	____	____	x	____	=	____
ACc-. & ACcc.	2-3+	____	____	x	____	=	____

SUMS = [____]= TNAP [1.00] [____] = WMTP
____ = bMTR

AGE CLASSES	ACYI	NUAC	RPRT	x	FRPA	=	WRAC
ACa-. & ACaa.	0-1	____	____	x	____	=	____
ACb-. & ACbb.	1-2	____	____	x	____	=	____
ACc-. & ACcc.	2-3+	____	____	x	____	=	____

SUMS = [____]= TNAP [1.00] [____] = WRTP
____ = bRPR

bMTR ____ + bRPR ____ = bPOP = ____

PRDN = 100 $e^{(\_\_\_\_\_)(YAPN)}$ = _____.

If YAPN = 1, PRDN =
If YAPN = 2, PRDN =
If YAPN = 3, PRDN =
If YAPN = 4, PRDN =
If YAPN = 5, PRDN =

CHAPTER 19, WORKSHEET 5.4b

The effects of changes in predation rates on net population growth

Using exponential predictions and the format given in WORKSHEET 5.4a, predict net population in relation to changes from year to year in the predation rate. Use the procedures for successive one-year cycles described in WORKHEET 4.2a, Page 56a. Be sure to incorporate new b values as the rates change.

AGE CLASSES	ACYI	NUAC	MTRT	x	FRPA	=	MWMA
ACa-. & ACaa.	0-1	____	____	x	____	=	____
ACb-. & ACbb.	1-2	____	____	x	____	=	____
ACc-. & ACcc.	2-3+	____	____	x	____	=	____

SUMS = [____]= TNAP [1.00] [____] = WMTP
____ = bMTR

AGE CLASSES	ACYI	NUAC	RPRT	x	FRPA	=	WRAC
ACa-. & ACaa.	0-1	____	____	x	____	=	____
ACb-. & ACbb.	1-2	____	____	x	____	=	____
ACc-. & ACcc.	2-3+	____	____	x	____	=	____

SUMS = [____]= TNAP [1.00] [____] = WRTP
____ = bRPR

bMTR ____ + bRPR ____ = bPOP = ____

PRDN = 100 $e^{(\_\_\_\_\_)(\_\_\_\_\_)}$ = _____.

* * * * * * * * * * * * * * * * * *

AGE CLASSES	ACYI	NUAC	MTRT	x	FRPA	=	MWMA
ACa-. & ACaa.	0-1	____	____	x	____	=	____
ACb-. & ACbb.	1-2	____	____	x	____	=	____
ACc-. & ACcc.	2-3+	____	____	x	____	=	____

SUMS = [____]= TNAP [1.00] [____] = WMTP
____ = bMTR

AGE CLASSES	ACYI	NUAC	RPRT	x	FRPA	=	WRAC
ACa-. & ACaa.	0-1	____	____	x	____	=	____
ACb-. & ACbb.	1-2	____	____	x	____	=	____
ACc-. & ACcc.	2-3+	____	____	x	____	=	____

SUMS = [____]= TNAP [1.00] [____] = WRTP
____ = bRPR

bMTR ____ + bRPR ____ = bPOP = ____

PRDN = 100 $e^{(\_\_\_\_\_)(\_\_\_\_\_)}$ = _____.

AGE CLASSES	ACYI	NUAC	MTRT	x	FRPA	=	MWMA
ACa-. & ACaa.	0-1	____	____	x	____	=	____
ACb-. & ACbb.	1-2	____	____	x	____	=	____
ACc-. & ACcc.	2-3+	____	____	x	____	=	____

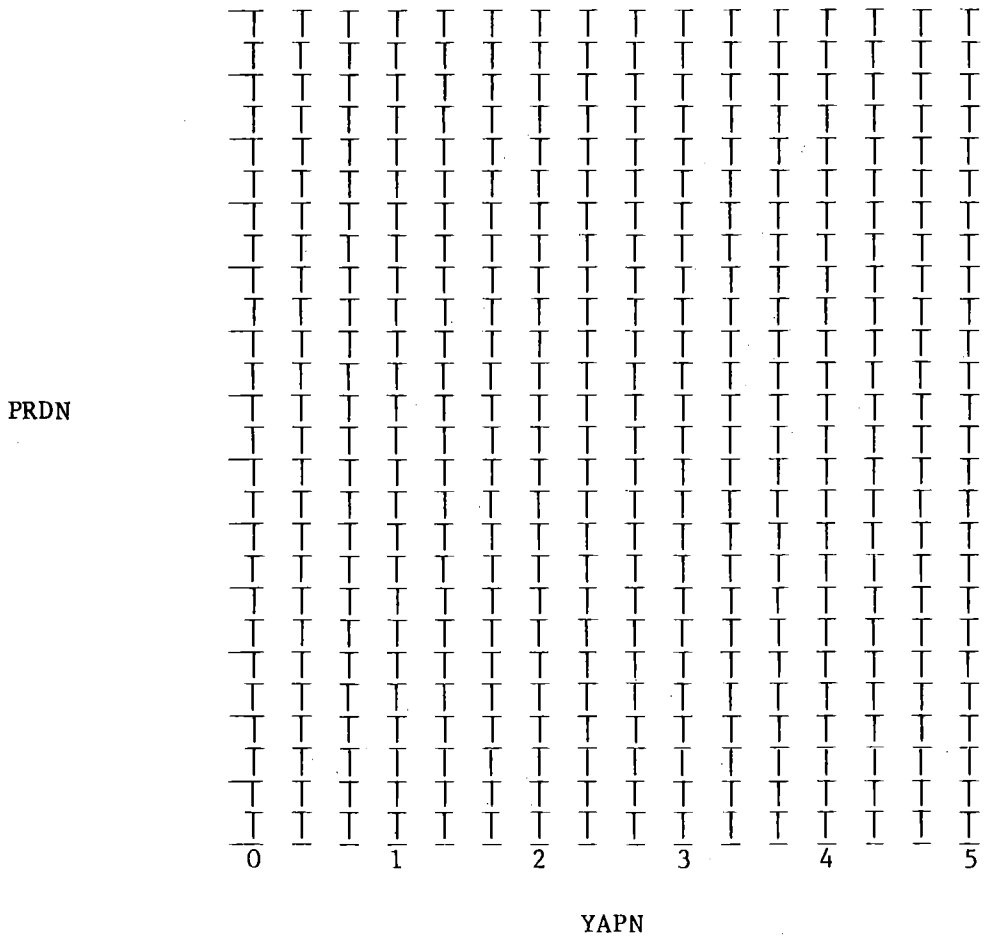
SUMS = [____]= TNAP [1.00] [____] = WMTP
____ = bMTR

AGE CLASSES	ACYI	NUAC	RPRT	x	FRPA	=	WRAC
ACa-. & ACaa.	0-1	____	____	x	____	=	____
ACb-. & ACbb.	1-2	____	____	x	____	=	____
ACc-. & ACcc.	2-3+	____	____	x	____	=	____

SUMS = [____]= TNAP [1.00] [____] = WRTP
____ = bRPR

bMTR ____ + bRPR ____ = bPOP = ____

PRDN = 100 $e^{(\_\_\_\_\_)(\_\_\_\_\_)}$ = _____.



UNIT 5.5: HIGHWAY AND RAILWAY MORTALITY

Highway and railway mortality is a part of the population dynamics of wild ruminants living in populated areas. The white-tailed deer, the most wide-spread and adaptable of wild ruminants, is the one species affected the most.

Highway amd railway mortality patterns are dependent not only on traffic patterns but on seasonal movements of the animals. Thus deer mortality increases in the fall during the rut when there is a higher level of activity and more movement, and in the spring during dispersal from winter concentration areas. Land conditions may cause short-term changes in mortality, too.

Evaluations of the effects of highway and railway mortality may be made for the time-periods through the year if such data are available, or for the entire year if necessary. It probably varies less, as a proportion of the population, from year to year than other causes of mortality; it may be a rather density-dependent rate. In fact, some biologists have used highway mortality figures as indicators of population levels.

REFERENCES, UNIT 5.5

HIGHWAY AND RAILWAY MORTALITY

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
CNSVA	19--2	2	3	odvi	secon deadliest deerslayer	burgin,be	1964
JWMAA	23--2	187	197	odvi	hwy mort, index pop change	jahn,lr	1959
JWMAA	35--2	232	237	odvi	mort, interst hwy, pennsyl	bellis,ed; graves	1971
JWMAA	37--2	212	216	odvi	road kills, pop trend, wis	mccaffery,kr	1973
JWMAA	38--1	16	19	odvi	mortali, interst hwy, mich	reilly,r; green,h	1974
JWMAA	38--4	799	807	odvi	factors, highway mortality	puglisi,mj; lindz	1974
JWMAA	39--3	570	581	odvi	distr, activ, intersta hwy	carbaugh,b; vaug/	1975
JWMAA	40--2	317	325	odvi	deer-car accidents, s mich	allen,re; mccullo	1976

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
XARRA	332--	1	4	odhe	mortal, interstat 80, wyom	goodwin,ga; ward,	1976

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

CAFNA 91--3 312 314 rata summer use hi-way crossing johnson,dr; todd, 1977

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 5.6: HARASSMENT

A number of factors in the natural environment may harass wildlife, including wild ruminants. The most common one over the years in populated areas has been dogs. They chase and harass deer effectively when snow conditions put the deer at a disadvantage.

A more recent sort of harassment is that of snowmobiles. These machines are capable of traversing a variety of snow conditions at high rates of speeds. Further, they have an unlimited supply of kinetic energy, never tiring as long as their gas tanks hold full for operation. Thus deer and other wild ruminants may be harassed to levels not experienced previously, depending on the attitude and behavior of the machine operator.

It is important to recognize that higher than natural levels of excitement are contrary to long-term energy conservation adaptations which wild ruminants possess (Moen 1976). My suggestion is that we be very conservative about the use of these machines in areas inhabited by deer or other ruminants, letting them live as naturally as possible. This opinion is further strengthened by the results (not yet published) of extensive measurements of heart-rate responses of white-tailed deer to snowmoblies at Cornell's Wildlife Ecology Laboratory. These deer showed no evidence of habituation to the noise as tests proceeded throughout the winter.

Harassment is difficult to convert to reduction in productivity. If harassment results in death, then the conversion is simple. If it simply results in reduced fetal weights, birth weights, etc., the effects are much more subtle.

LITERATURE CITED

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

REFERENCES, UNIT 5.6

HARASSMENT

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
ECOLA	57--1	192	198	odvi	energ cons by, in the wint	moen,an	1976
JWMAA	22--2	184	192	odvi	mobility, misso keer, dogs	progulske,dr; ba	1958

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

CWPNB 79--- 1 23 rata obsrv respn helicop harass miller,fl; gunn,a 1977

FUOFA 67... 250 253 rata magpies attack reind, swed espmark,y 1972

FUNAA 22... 265 266 rata raven attacking reindeer ostbye,e 1969

JEBCA 74... 34 36 rata insects, alpine region, bc harling,j; snyde/ 1977

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 5.7: CHEMICAL FACTORS

The introduction of chemical factors into the environment in the last 30 years has presented new problems for wildlife biologists to solve and respond to. Pesticides, herbicides, and inorganic fertilizers have been spread over large areas of forested and agricultural lands, and these have entered metabolic pathways of wild ruminants, through the plants they have consumed. Many of these chemicals are passed on to other organisms in the food chain.

Not all of the chemicals have harmful effects. Their ecological effects on wild ruminants may be more subtle than the effects on target species; tiny insects might be killed by an insectide that would only alter metabolism of a large animal for a short time, for example. The effects of repeated exposure, however, might suppress productivity.

FACTORS AFFECTING THE PHYSIOLOGY AND METABOLISM OF WILD RUMINANTS are discussed in CHAPTER 10. There are a good number of references in the SERIALS list that may be useful when evaluating the effects of chemicals on net population productivity.

REFERENCES, UNIT 5.7

CHEMICAL FACTORS

SERIALS

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

PCGFA 25--- 23 30 odvi prelim surv, pestic residu cotton,d; herring 1971
PCGFA 25--- 31 45 odvi pestici residues, s caroli barrier,mj; reed, 1971

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

JWIDA 10--2 166 169 odhe invest, tansy ragwort pois dean,re; winward, 1974

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

ceel

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

PEMJA 7---2 97 99 alal organo chlor residu, idaho benson,ww; watso/ 1973

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

BECTA 19--1 23 31 ovca chlor hydrocarb resid, fat turner,jc 1978

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

JWIDA 37--1 1 11 ceni potas def: facto mass mort christian,jj 1964

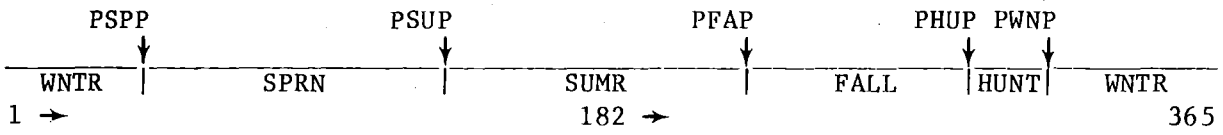
SEE CHAPTER 10 SERIALS LIST ALSO

UNIT 5.8: OTHER AND ALL FACTORS

There are a number of other factors that have the potential for altering net population productivity, in addition to the seven factors already listed. These other factors are best described as "accidents," or occasional causes of changes. Drowning, choking, lightning . . . these are not the basic everyday factors than must be overcome by wild ruminants. Their occurrences have been reported in the literature, and references are listed in the SERIALS at the end of this UNIT.

All factors affecting net population growth should be considered through the annual cycle, with each year divided into as many functional time periods as you can justify with the data base available. Total annual mortalilty is the sum of the mortalities during each time period.

The five time periods introduced at the beginning of this CHAPTER are:



Reorganizing this in tabular form, the following lists of causes of mortality and production rates are helpful reminders of factors to consider.

		CLASS	Mortalities		CLASS	CORT	BIRT	WERT
PHUP	____	____	Hunting	____	____	____	____	____
		____		____				
		____		____				
PWNP	____	____	Crippling loss	____	____	____	____	____
		____		____				
		____		____				
PSPP	____	____	Poaching	____	____	____	____	____
		____		____				
		____		____				
PSUP	____	____	Predation	____	____	____	____	____
		____		____				
		____		____				
PFAP	____	____	Winter losses	____	____	____	____	____
		____		____				
		____		____				
		____	Road kills	____				
		____		____				
		____		____				
		____	Other causes	____				
		____		____				
		____		____				

Using weighted-mean tabular formats as illustrated in previous WORKSHEETS, master WORKSHEETS may be constructded for as many classes, causes of mortality, and production rates as you wish. The final values of bPOP enable you to calculate predicted populations very quickly.

REFERENCES, UNIT 5.8

OTHER AND ALL FACTORS

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
JOMAA	48--4	655	656	odvi	hypothermia, water-chill d	moen,an	1968
JOMAA	49--1	148	148	odvi	possibl hered defect, mich	verme,lj	1968
JWMAA	9---1	76	78	odvi	weathr and the kill, maine	fobes,cb	1945
MOCOA	20--9	1	3	odvi	cause of death- accidental	murphy,da	1959
NYCOA	29...	31		odvi	wintring deer vs snowmobil	severinghaus,cw;/	1975
WDABB	3---4	184	184	odvi	accidental choke, w-t deer	fisher,fp	1967

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
AMNAA	83--1	303	304	odhe	accidents, parturient deer	miller,fl	1970
JOMAA	37--2	143	164	odhe	behav with ref to pop ecol	dasmann,rf; taber	1956
JOMAA	46--4	676	676	odhe	mule d killed by lightning	reynolds,hg	1965
JWMAA	16--1	113	114	odhe	bearded grains cause death	winter,kb; honess	1952
JWMAA	40--1	140	144	odhe	odvi, drought infl numbers	anthony,rg	1976
NEXAA	567--	1	32	odhe	ft stanton hrd, ecol, n mx	wood,je; bickle,/	1970

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
JOMAA	50--3	640	641	ceel	inciden, mass elk drowning	martinka,cj	1969
NAWTA	20---	560	567	ceel	increas natal, lower popul	buechner,hk; swan	1955

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
AMNAA	91--2	435	438	alal	init resp wildfre, ne minn	peek,jm	1974
JWIDA	8---1	95	98	alal	fatality from overext rnge	miller,fl; broug/	1972

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
JWMAA	18--4	521	526	rata	fire and decline of a herd	edwards,ry	1954
NPOAA	1976-	129	136	rata	pop size, reprod, svalbard	alendal,e; byrkje	1976
ORYXA	7....	240	246	rata	the decline of the caribou	kelsall,jp	1964

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
NEXRA	245--	1	12	anam	factrs restr increa, n mex	howard,vw,jr; en/	1973

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
JOMAA	35--3	453	454	bibi	buffalo killed by fire	cole,je	1954

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
CAFGA	55--3	237	238	ovca	losses, natural trap tank	mensch,jl	1969

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
ANBEA	24--4	756	758	obmo	rutting fight mortali, nwt	wilkinson,pf; sha	1976
IZYBA	5----	58	75	obmo	herd of musk-oxen in capti	oeming,a	1965

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

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
AMNTA	104--	1	24		life hist conseq, nat sele	gadgil,m; bossert	1970
BEHSA	15--1	101	115		natur select, defined popu	istock,ca	1970
ECOLA	51...	823	828		detect, regula in anim pop	st amant,jls	1970
ECOLA	52--3	453	468		density-depend natur selec	roughgarden,j	1971
JWMAA	20--2	159	168	many	snow depths & ungul abunda	edwards,ry	1956
JWMAA	34--4	681	690		nat selec, param pop growt	hairston,ng; tin/	1970
NAWTA	3----	296	301	biga	fact control pop, rocky mt	couglas,lh	1938

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
CPSCA	1---2	79	95	ceni	factors, mass mort, sika d	christian,jj; fl/	1960

CLOSING COMMENTS

CHAPTER 19, POPULATION RATES AND PREDICTIONS has dealt with natality and mortality rates and how to use them when predicting population changes. Discussions have been diverted toward the practical year-to-year use of sex, age, and weight data as a basis for decision-making, rather than long-range population theory. If the WORKSHEETS in this CHAPTER 19 have been completed, then the basic calculations in CHAPTER 20 will be very easy to make.

Aaron N. Moen
June 25, 1981

GLOSSARY OF SYMBOLS USED - CHAPTER NINETEEN

ACEY = Age class by end of year
ACMP = Age class at the midpoint
ACYI = Age class by yearly intervals
ADRR = Adult reproductive rate
AGCL = Age class

BIRT = Birth Rate
BIWK = Birth weight in kg

CLWK = Calculated maximum live weight
CORT = Conception rate

FALL = The weight recovery period following weaning of the young and up to the hunt
FARR = Fawn reproductive rate
FEPF = Fetuses per female
FFPA = Fraction of the female population in the age class
FFPW = Fraction of the female population in this weight class
FMPA = Fraction of the male population in each age class
FMPW = Fraction of the male population in this weight class
FRPA = Fraction of the population in each age class
FWMA = Weighted mortality rate of each age class
FWMP = Weighted mean mortality rate of the population
FWMW = Weighted mean mortality rate for each weight class

HUNT = The period in the fall when the hunting season is open

MAWK = Maximum weight in kilograms
MFSR = Male to female sex ratio
MTRT = Mortality rate
MWMA = Weighted mean mortality rate for each age class
MWMP = Weighted mean mortality rate of the male population
MWMW = Weighted mean mortality rate for each weight class

NAIP = Number of animals present in the initial population
NBMO = Number of mortalities
NFAC = Number of females in the age class
NFER = Number of females recruited into the population
NFWC = Number of females in each weight class
NFYR = Number of female young recruited into the population
NMAR = Number of males recruited into the population
NMWC = Number of males in each weight class
NMYR = Number of male young recruited into the population
NSAC = Number of surviving in each age class
NTMR = Natal mortality rate
NTSR = Natal survival rate
NUAC = Number in the age class
NYPF = Number of young per female

PFAP = Prefall population
PHVP = Prehunt population
PRDN = Predicted N
PSPP = Prespring population
PSUP = Presummer population
PWNP = Prewinter population

RCRT = Recruitment rate
RPRT = Reproductive rate

SPNG = The time from the end of winter to parturition
SUMR = The time preiod from parturition through weaning of the young
SUMS = Sums
SURT = Survival rate

TNAP = Total number of animals in the population
TNFP = Total number of females in the population
TNMP = Total number of males in the population

WBRA = Weighted mean birth rate for each age class
WBRP = Weighted mean birth rate of the population
WCMP = Weight class at the midpoint
WCRA = Weighted mean conception rate for each age class
WCRP = Weighted mean conception rate of the population
WCRW = Weighted mean conception rate for each weight class
WERT = Weaning rate
WMTP = Weighted mean mortality rate of the total population
WNTR = The period following the hunt when winter conditions are expected
WRAC = Weighted mean reproductive rate of the age class
WRCA = Weighted mean recruitment rate of the age class
WRCP = Weighted mean recruitment rate of the total population
WRTP = Weighted mean reproductive rate of the total population
WTCL = Weight class
WWRA = Weighted mean weaning rate for each age class
WWRP = Weighted mean weaning rate of the population

YABD = Yearling antler beam diameter in mm
YAPN = Years ahead one wishes to predict N
YDWK = Yearling dressed weight in kg
YERR = Yearling reproductive rate
YLWK = Yearling calculated live weight in kg

GLOSSARY OF CODENS - CHAPTER NINETEEN

AJANA	American Journal of Anatomy
ALLKA	Allattani Kozlemenyek (Hungary)
AMFOA	American Forests
AMNAA	American Midland Naturalist
AMNTA	American Naturalist
AMZOA	American Zoologist
ANBEA	Animal Behaviour (England)
ANREA	Anatomical Record
ATICA	Arctic (Canada)
ATRLA	Acta Theriologica (Poland)
AUKJA	Auk
AVSPA	Acta Veteinaria Scandinavica Supplementum (Denmark)
BEHAA	Behaviour (Netherlands)
BEHSA	Behavioral Science
BIOMA	Biometrics
BIREB	Biology of Reproduction
BISNA	Bioscience
BJDIA	Bijdragen tot de Dierkunde
BPURD	Biological Papers of the University of Alaska Special Report
CAFGA	California Fish and Game
CAFNA	Canadian Field Naturalist
CJZOA	Canadian Journal of Zoology
CNDRA	Condor
CNSVA	Conservationist
COVEA	Cornell Veterinarian
CPSCA	Chesapeake Science
CWPNB	Canadian Wildlife Service Progress Notes
CWRSB	Canadian Wildlife Service Report and Management Bulletin Series
DRCWD	Colorado Division of Wildlife Division Report
ECMOD	Ecological Modeling
ECOLA	Ecology
EKIAA	Ekologiya
FUNAA	Fauna (Oslo)
FUOFA	Fauna och Flora
GRBNA	Great Basin Naturalist
HMECA	Human Ecology
ISJSA	Iowa State Journal of Science
IZYBA	International Zoo Year Book

JAECA Journal of Animal Ecology
JAVMA Journal of the American Veterinary Medical Association
JBLPA Jelen
JEBCA Journal of Entomological Society of British Columbia
JFUSA Journal of Forestry
JOMAA Journal of Mammalogy
JRPFA Journal of Reproduction and Fertility
JTBIA Journal of Theoretical Biology
JWIDA Journal of Wildlife Diseases
JWMAA Journal of Wildlife Management

MDCRA Michigan Department of Conservation Game Division Report
MOCOA Missouri Conservationist
MRLTA Murrelet, The
MRYCA Maryland Conservationist
MUOXD Musk-ox

NAWTA North American Wildlife and Natural Resources Conference, Transactions of the, NCANA Naturaliste Canadien, Le
NCANA Naturaliste Canadien, Le
NEXAA New Mexico Agricultural Experiment Station Bulletin
NEXRA New Mexico Agricultural Experiment Station Research Report
NFGJA New York Fish and Game Journal
NOSCA Northwest Science
NPKMA National Parks Magazine
NPOAA Norsk Polarinstituut Arbok
NYCOA New York State Conservationist

OETAT Oregon Agricultural Experiment Station Technical Bulletin
OJSCA Ohio Journal of Science
ORYXA Oryx

PASCC Proceedings of the Alaskan Scientific Conference
PCGFA Proceedings of the Southeastern Association of Game and Fish Commissioners
PEMJA Pesticide Monitoring Journal
PIAIA Proceedings of the Iowa Academy of Science
PMACA Papers of the Michigan Academy of Sciences, Arts and Letters
PNASA Proceedings of the National Academy of Sciences of the United States

QJFAA Quarterly Journal of the Florida Academy of Science
QRBIA Quarterly Review of Biology

SCIEA Science

SWNAA Southwestern Naturalist

TISAA Transactions of the Illinois State Academy of Science
TLPBA Theoretical Population Biology
TNWSD Transactions of the Northeast Section, The Wildlife Society
TWASA Transactions Wisconsin Academy of Sciences, Arts, and Letters

UTSCB Utah Science

VILTA Viltrevy
VIWIA Virginia Wildlife

WDABB Bulletin of the Wildlife Disease Association
WLMOA Wildlife Monographs
WLSBA Wildlife Society Bulletin
WSCBA Wisconsin Conservation Bulletin
WVAFA West Virginia Agriculture and Forestry

XARRA U S Forest Service Research Note RM
XFNCA U S Forest Service Research Paper NC
XFWLA U S D I Fish and Wildlife Service, Wildlife Leaflet

ZEJAA Zeitschrift fuer Jagdwissenschaft

LIST OF PUBLISHERS - CHAPTER NINETEEN

acpr	Academic Press	New York	nyny
amel	American Elsevier Publ. Co., Inc.	New York	nyny
dove	Dover Pub. Co.	New York	nyny
fost	Forest and Stream Publishing Co.	New York	nyny
isup	Iowa State University Press	Ames, IO	amia
jwis	John Wiley and Sons, Inc.	New York, NY	nyny
meth	Methuen & Co., Ltd.	London	loen
olbo	Oliver and Boyd	Edinburgh, Scotland	edsc
oost	Oosterbeek	The Netherlends	neth
prup	Princeton Univ. Press	Princeton, NJ	prnj
saco	Saunders Publishing Co.	Philadelphia, PA	phpa
ualb	University of Alberta Press	Edmonton, Alberta	edal
uchp	Univ. of Chicago Press	Chicago, IL	chil
utnp	Univ. Tennesse Press	Knoxville, TN	kntn
whfr	W. H. Freeman Co.	San Francisco, CA	sfca
wiso	Wildlife Society, The	Washington, D.C.	wadc
wmmo	Wm. Morrow and Co.	New York	nyny

LIST OF WORKSHEETS - CHAPTER NINETEEN

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.